November 1983 Volume 2 $2.50

softalk

for the IBM Personal Computer

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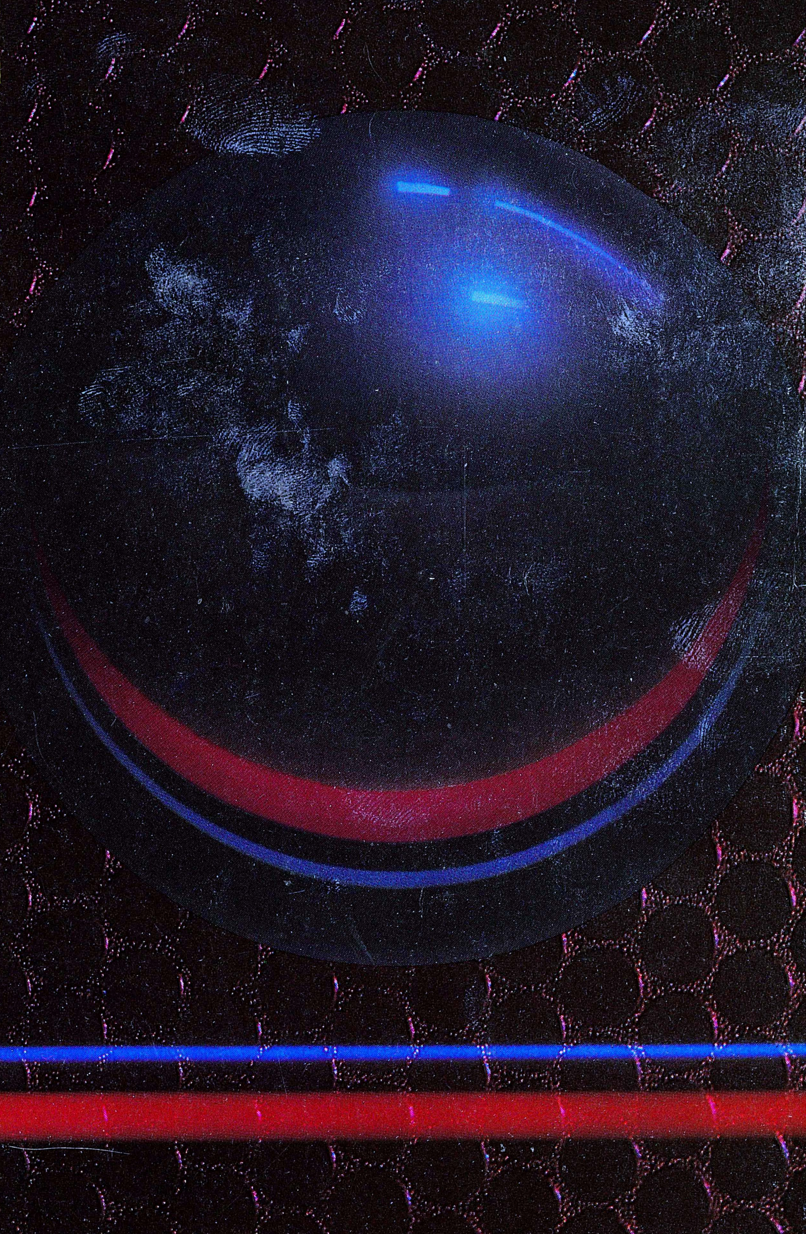

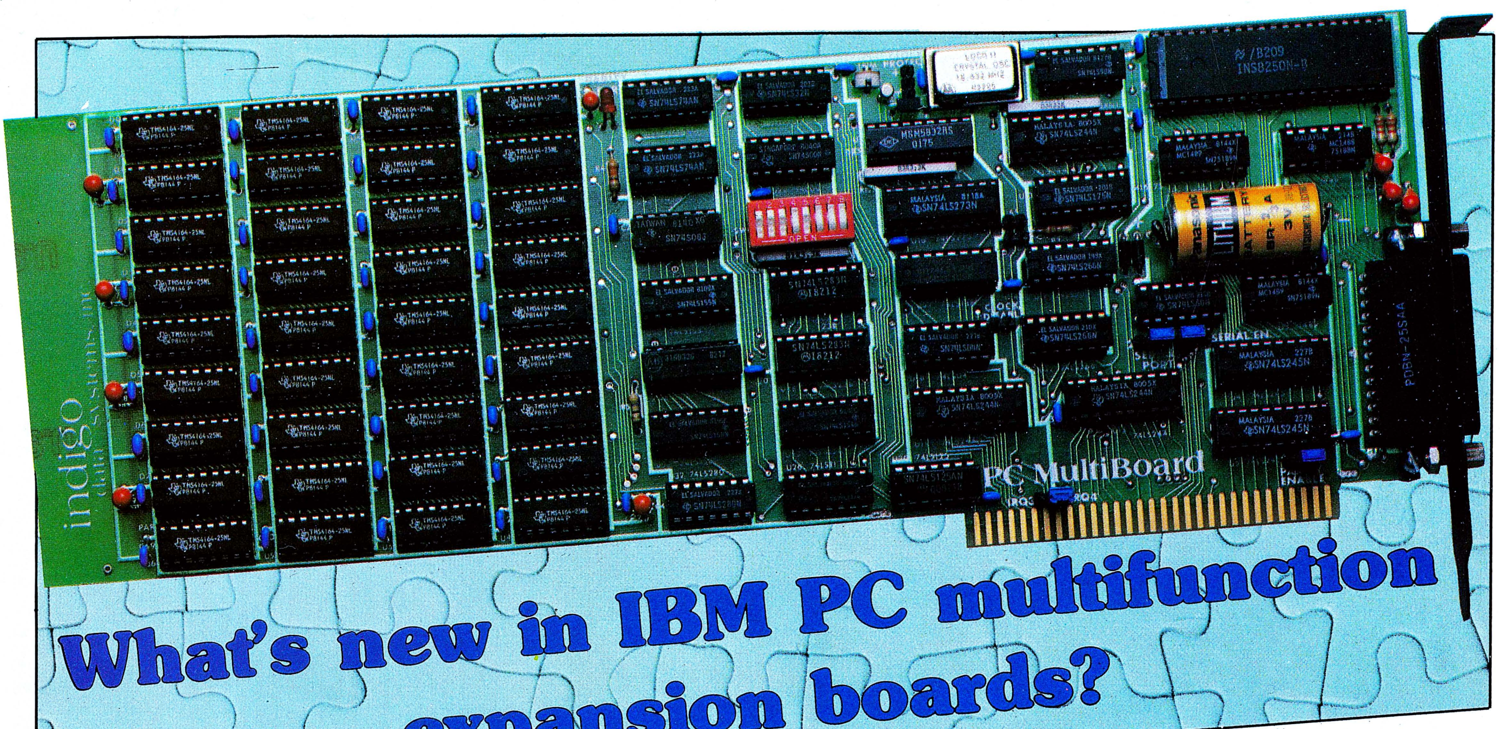

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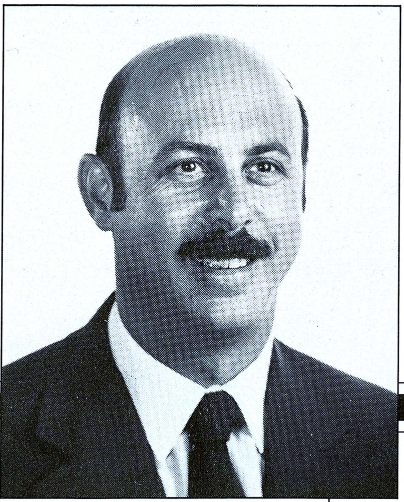

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By Ken Silverman,
President, International Datawares, Inc.

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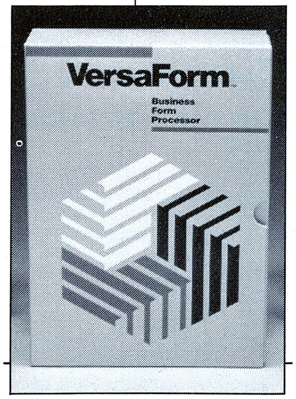

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WINNERS

```
10 CLS:LOCATE 20,10: PRINT "The response to the one-line program contest was overwhelming. Winners will be announced next issue after we dig out. ":FOR I=1 TO 3000:NEXT I:CLS
```

Diskette
DOS
in A
Printer

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* DOS likes to announce itself by typing A>. The cursor sits next to the >.
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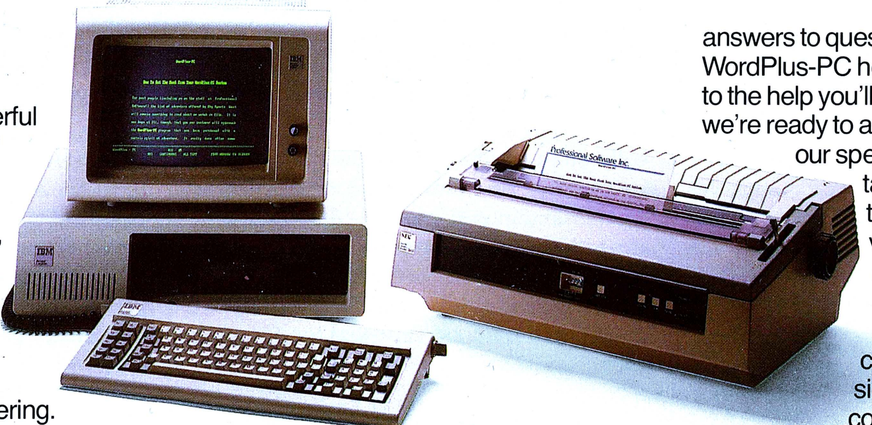

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crosstalk

Fun with Life

When I saw my article, "The Game of Life," in the September issue of *Softalk*, I noticed a couple of minor mistakes. First the screen area is 50 by 25 cells wide, not the 50 by 235 or 50 by 50 mentioned.

The other mistakes deal with turning comment statements (* and *) into just (and). This seemingly unimportant change will probably render the program uncompilable. There are six statements at the beginning of the program that should be comments. The six statements start with (*$TITLE: and go through $STACKCK-*). For each of those statements, the simple parentheses must be turned into the comment parentheses (* and *) or { and }. There is one more comment that needs to be changed. It occurs in the PROCEDURE SET_UP. In the CASE statement there is an OTHERWISE clause with the comment after it. The comment should be (*VALID KEY NOT USED*). Note that the parentheses have been changed to comments.

With the corrections mentioned here, everyone should be able to have fun with Life.

Robert Fruit, Hinsdale, IL

In Defense of Defense

I'd like to express my appreciation for the fine mix of articles in your magazine. I've found many interesting programming tricks in your articles and in the letters from users. I also appreciate the articles showing the immense range of uses the IBM pc is being put to. The spectrum of uses never ceases to amaze me—from geology to defense to medical to heaven knows what.

Since I find these uses so interesting, I was surprised to see a letter in the September issue complaining about the article "Automating America's Air Defense: A Network of XTs Stands Ready" (June 1983). It should have come as no surprise, as I've often noted that the disciples of Neville Chamberlain (or perhaps Andropov) will try to get their political maunderings into any and all media in order to show their resentment of America's willingness to have armed services for defense. His hope that we would dismantle such systems as the Alaskan Defense System seems ironic in view of the recent Korean Airlines incident.

Please continue to exercise your editorial judgment as in the past and keep giving us the same fine variety of information.

George L. Hopkins, Greensboro, NC

MicroPro Redeemed

MicroPro has pretty regularly been criticized in these (and other) pages for not providing much in the way of end-user support for *WordStar* and its other programs. A few months ago, prompted by a letter I saw in "Crosstalk," I wrote MicroPro for an extended user-patch listing, fully expecting to be disappointed.

I wasn't! In two weeks I received an extensive listing that enabled me to customize several different versions of *WordStar* for program source code and data files, long and short documents, and Epson and letter-quality printers. MicroPro has apparently decided, as have many other publishers, that one of the best protections against piracy is not copy protection but active end-user support. They should be congratulated.

Robert L. Wears, Orange Park, FL

Useless Utilities

First, I would like to take the opportunity to express my gratitude to Softalk Publishing for producing a good, solid, meat and potatoes magazine devoted to the pc; it may not have the pizzazz of the "big two" but, in my judgment, it is far ahead of both of them in substance.

If the auto industry is any harbinger of things to come in the field of computers, there will soon be a very significant shift taking place in the demography of personal computer users. Indeed, one could persuasively argue that the shift has already begun to take place.

In the early years of the auto, the preponderant majority of users were the tinkerers, the quasi-mechanics, and the skillful amateur automotive engineers who could lift the hood of a vehicle, grab a handful of tools, and make a recalcitrant engine shape up. Today, the overwhelming majority of auto users cannot tell the difference between a distributor and a regulator.

From my vantage point, this is not the case in the field of the personal or home computer either. Yet there appear to be some folks in the field who have not yet recognized this change, one that will be as critical to the computer industry as it was to the automobile business. DR (Dan Robinson, I would guess), who reviewed the *Norton Utilities* in your September issue, is a good case in point.

In his review DR states that the *Norton Utilities* are "as simple to use as they are effective [and that they are] as simple, reliable, and easy to use as a screwdriver." This may be true if one is a tinkerer or a skillful amateur computer scientist. But I submit that if one is part of the burgeoning tide of users who know only how to "fire up the engine and go," the simplicity of the *Norton Utilities* is questionable.

Having a damaged disk to contend with, I purchased the *Norton Utilities* on the advice of a friend. Invoking the SSAR program, as the documentation advises, I received the following screen message for my pains:

```
? Error: File name error in file b:
  Error Code 1005
PC = 32D: 667, FP = E788, SP =
E782
```

followed by the DOS prompt.

Now I challenge DR on the basis of the *Norton Utilities* documentation alone to tell me just exactly what the message means. I have challenged others to do so (including Mr. Norton himself, who declined to answer the question) without success, although most of them had lauded the *Norton Utilities* beforehand. I'm inclined to think that it's another case of the "emperor's new clothes" and that Mr. Norton's apparently well-deserved reputation as an outstanding intellect in the field of computer science had as much to do with DR's review as did the latter's own hands-on analysis of the *Utilities*—perhaps even more.

Now I'm willing to concede that in matters computer-scientific I'm apparently just a plain knucklehead. But I believe that I have plenty of company in the realm of computer-knuckleheadedness and that we computer illiterates are a rapidly growing percentage of end users.

Consequently, I suggest that in future software reviews, reviewers qualify their reports

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as to whether it is for the pro or for the amateur. I hope that since more and more readers are the fire-up-and-go type, reviewers will develop the necessary skill to address their reports to the full spectrum of readership.

Irving David Shapiro, Oakland, CA

Graphics Plots

I would like to write compiled programs in BasicA that will include a test to determine if the monochrome and/or color cards and monitors are available. If only the mono card is present, the programs would not attempt to perform graphics plots. If only the color board is present, the programs would automatically allow the user to plot graphics. If both cards are available, the programs would ask which card to use or allow text to be directed to the monochrome monitor and graphics to the color/graphics monitor. With the array of talent that you have writing (and reading) *Softalk*, you should easily find a solution to this problem. I expect that many readers will be interested in your solution.

M. Daniel Vanderbilt, Fort Collins, CO

See "The Basic Solution," in the June 1983 issue. If you don't have that issue, you may obtain it by sending $3 to Softalk/IBM Back Issues, Box 60, North Hollywood, CA 91603.

p-System

As I read John Socha's article, "Comdex: The Spring Harvest," in the June 1983 *Softalk*, I became more and more uncomfortable with his coverage of the p-System. While I appreciate his inclusion of SofTech Microsystems's p-System, his review contained several inaccuracies that need to be corrected.

Socha wrote that we had rewritten the p-System, suggesting that we had done this very recently. Furthermore, he said that we had done this rewriting to achieve portability. Full-scale object code portability has always been the hallmark of the p-System. While we initially marketed Version II of the p-System, Version IV was introduced two years ago as an enhancement of Version II, not a rewrite. We at SofTech Microsystems continually strive to improve and enhance our software products, and we have achieved this without rewriting them.

Next, Socha misunderstood my comments on the application development environment the p-System provides. In the p-System we strive to provide the best application development environment available on personal computers. However, it has always been our philosophy that the best application development environment is one that allows the best applications to be written. We have not "forgotten that programs are ultimately used by users." On the contrary, many of the capabilities offered by the p-System to the application programmer allow bigger, better, and more

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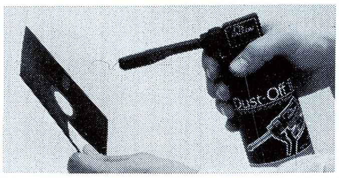

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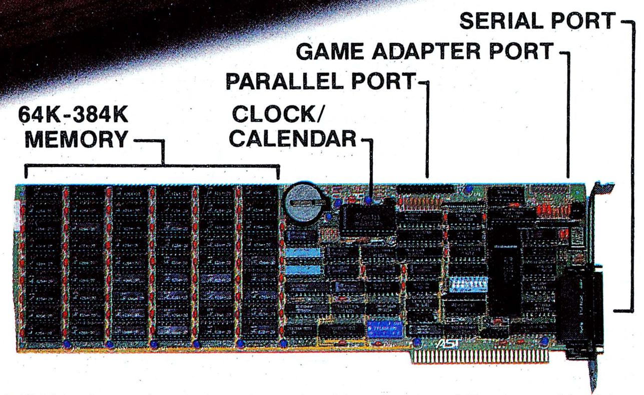

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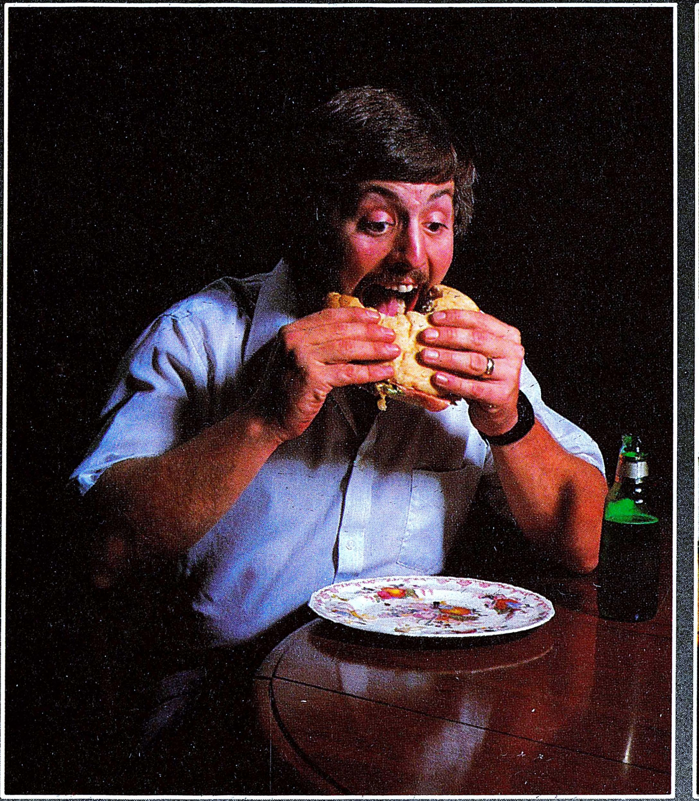

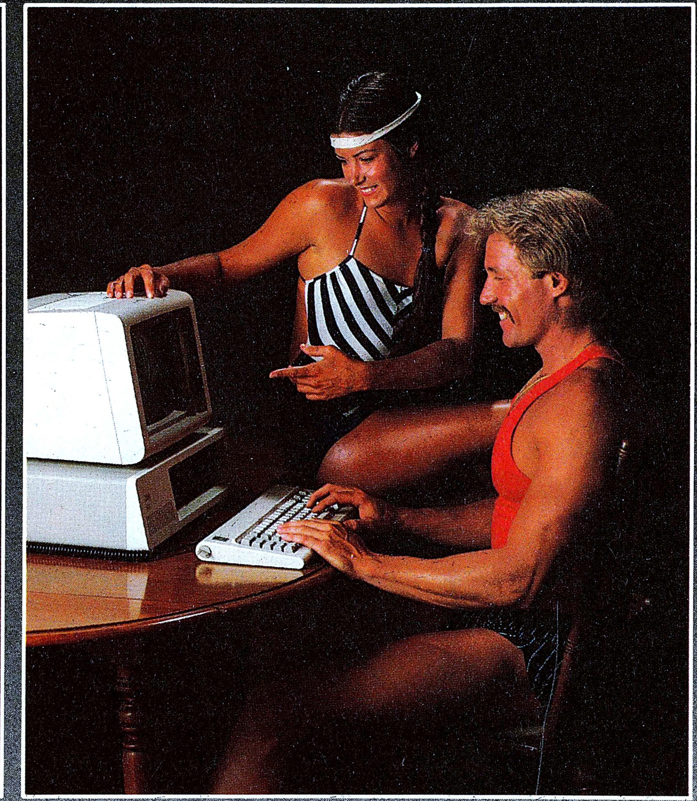

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user-friendly applications to be written, and written more easily. Although the p-System provides special facilities allowing the application developer to hide the operating system entirely within a "turnkey" application package, it was also the first personal computer operating system to use hierarchic menus and single-keystroke selection from those menus.

John's remarks about the byte-sex issue were also somewhat misleading.

The p-System incorporates several mechanisms that ensure that object code programs are in fact portable across machines of differing "byte-sex." Data files are, unfortunately, a different technical issue. Character (text) files are, of course, fully byte-sex-portable. Data files containing integers, floating point numbers, and/or mixtures of such arithmetic constants and text present very different problems. To put it simply, different machines use very different formats for arithmetic constants, and the operating system cannot know the detailed record structure of application data records. It is, therefore, impossible for the p-System automatically to convert such constants to the correct host format. There are, however, application programming practices that produce programs that can, for their data files, accommodate byte-sex variations. All of our software development products do just that, and there are many applications that do so as well. I think that it would also have been fairer had John pointed out that no other operating system allows object code portability across different microprocessors with the same byte-sex!

Socha's statement that the p-System, especially on the IBM pc, is "painfully slow" is just not true. That is a generalization he would be hard put to tag on any system. In fact, there have been several benchmarks published that rate the p-System very high on the performance scale. The 68000-based Sage computer running the p-System was reported as among the fastest of many machines/languages/operating system combinations in a widely published benchmark (see January 1983 *Byte* Benchmark). If the p-System is slow, these benchmarks have proven that other operating systems are painfully slower.

Finally, his "too little, too late" comment is too much of an editorial statement for me to let go by without response.

We firmly believe that the operating sytem war is not yet over. In the last two months alone we have added Wang, Epson, NCR, NEC, and Olivetti to an OEM list that already included IBM, DEC, Zenith, TI, Commodore, and so on. In short, we have made a solid commitment to increase the p-System's market share, and we are confident you will see SofTech Microsystems and the p-System emerge as one of the victors on the OS front. (By the way, while we may have some bias, we are not alone in this belief. The fall readership study conducted by *PC Magazine* indicated we have surpassed CP/M-86 in popularity on the IBM pc!)

C.A. Irvine, SofTech Microsystems,
San Diego, CA

I've used the UCSD p-System for several years, first on an Apple II and then on an IBM pc, and I very much like the p-System for writing ordinary Pascal programs. But I prefer to use MS-DOS because most of the programs I use are written for it. There is so much momentum behind DOS that SofTech won't easily convince many people to convert to the p-System. And, although SofTech offers true portability—that is, the p-System allows one program to be used on several different microprocessors without change—speed still seems to be a more important issue on the pc.

Although the p-System on a 68000 computer is very fast and a delight to use, the 68000 is a much faster microprocessor than the pc's 8088. Programs written for the p-System on a pc, such as MBA, *haven't fared well against similar programs written for DOS, partly because they're slower and partly because most*

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John Socha, Ithaca, NY

Where Is *Wizardry?*

I am writing about the article "Winning at *Wizardry*" (February 1983), by Forrest Johnson. Mr. Johnson said that Sir-tech Software had come out with *Wizardry* for the IBM pc. I have looked in many software stores, but I have not yet found *Wizardry.*

I would like to know if Sir-tech has or will come out with *Wizardry* for the pc. If it has already come out, where can I get it, or, if it is yet to come out, when is it due?

Robert Albert, Sunnyvale, CA

The folks at Sir-tech tell us Wizardry *for the pc has been delayed and they expect it to be available around January. A spokesperson says the company's announcement of the game for this market was a little premature.*

Resetting Kolor.com

I've written a simple program to be used in conjunction with George Bohannon's Kolor.com ("Add Color to Your Text," June 1983). My program is called Reset.com and does nothing more than replace the original video call vector to ROM BIOS. Kolor.com inserts its own address so that all calls to the video interrupt will be intercepted and processed by the program.

I took George Bohannon's Kolor.bas format and wrote Reset.bas, which creates the file Reset.com (the Basic version is twenty-one bytes long). After creating the file and running it, you will not see any change until you clear the screen or use any other video call such as scrolling. One important thing to remember is that each time Kolor.com is run, another copy is stored in memory (496 bytes). If the program is run too many times, you may run out of memory.

There are two reasons why I'm offering these programs: First, I thought someone might like to switch colors after running Kolor.com without having the chaining effect that occurs if Kolor.com is run more than once (or possibly if someone just wants to turn off the color without having to reboot). Second, I wanted to show off my first and only assembler program, which was created just by reading the listing in George's article! That may not sound like much of an accomplishment to some people, but it made me very happy to see the program actually work.

I started with the program Resetvid.bas, which is a simple Basic program used to poke the original call vector back into location. Alas, the color-coded batch files I was working on took too long to load Basic and execute. I tried to compile the program, only to find that the Basic compiler had created a file of 18K bytes just to poke four bytes of code into lower memory.

There was only one answer left—the Macro Assembler. It didn't appear to be difficult to place a couple of bytes into memory at a specific location, although for a novice anything to do with machine language can be somewhat frightening.

Well, it took quite a few hours and I occasionally sent my computer into the ozone, but finally—SUCCESS! The final result was a twenty-byte .com program that was easily included into my batch file system of color selection.

I'm sure a seasoned assembly-language programmer would find this exercise simple and might even wonder why I didn't use INT 21 function 25, which invokes the DOS function to set an interrupt vector, but I read about it after I wrote Reset.com.

I hope Reset.com is useful for those of you using George Bohannon's Kolor.com. If anyone would like a copy of the menu-driven color selector based on Kolor.com, send me a disk in a prepaid return mailer to 87 Nelson Street, Farmingdale, NY 11735, and I'll send you a copy.

Tim Mason, Farmingdale, NY ▲

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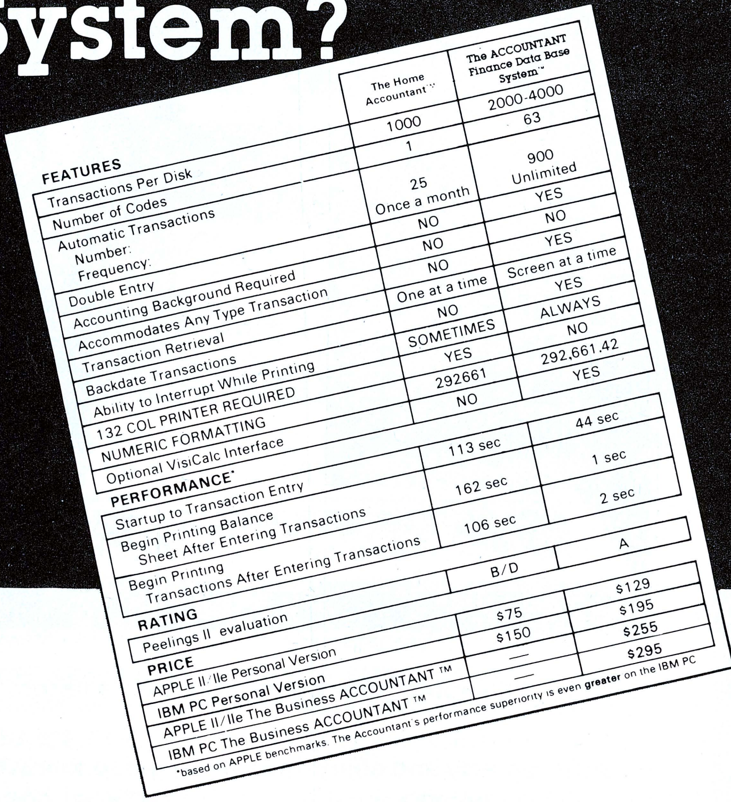

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2. Mail subscription	196	496
C. Total paid circulation	1,940	3,026
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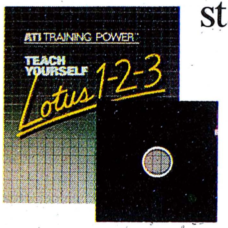

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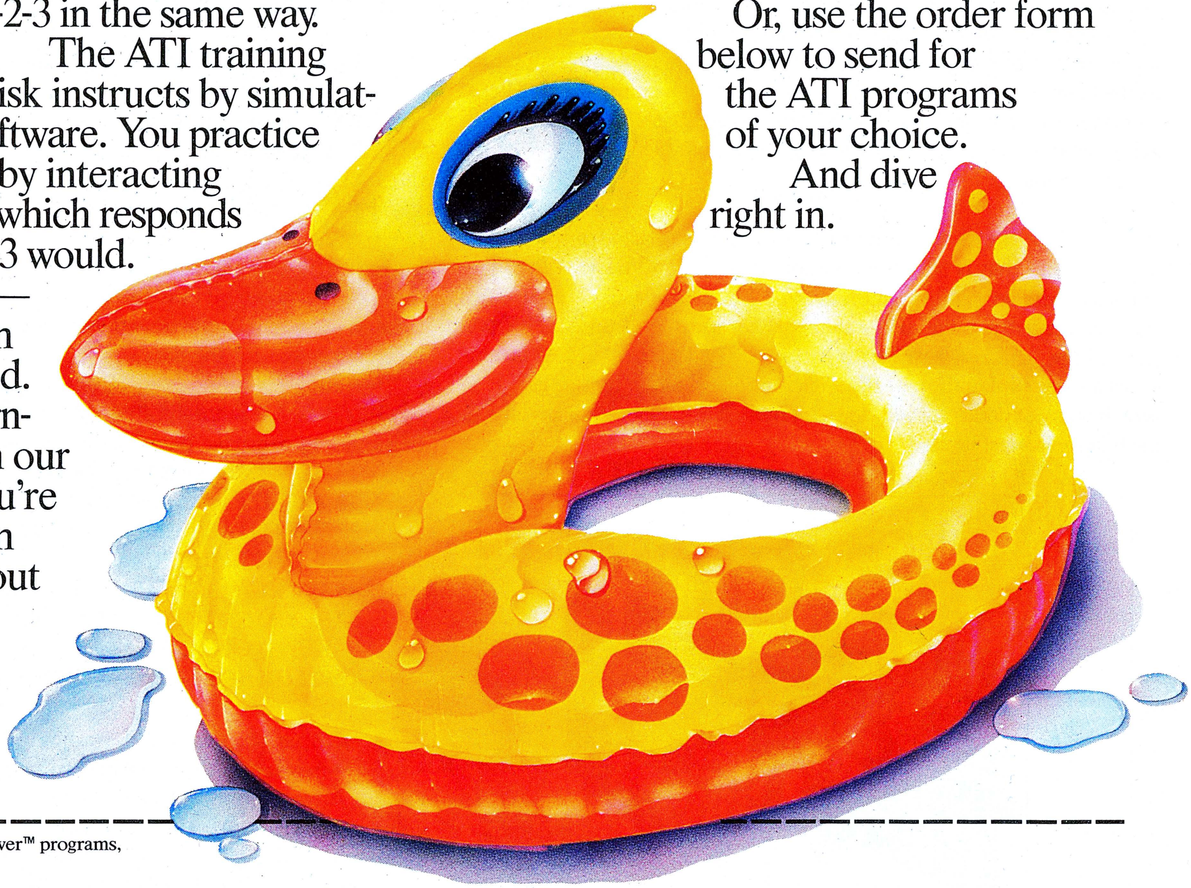

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QUESTIONS & ANSWERS

by Nancy Andrews

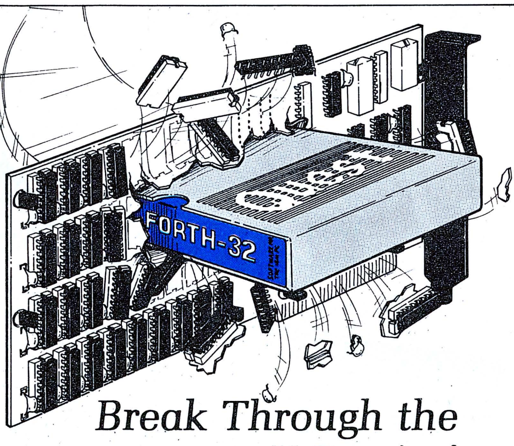
Q: In the August issue you mentioned the *shell* command; I have not been able to find any documentation on that command. I have tried it out and it seems to work to a degree.

I used the *shell* command to execute a .bat file. I then got a DOS prompt, which indicated to me that I was back in DOS, so I tried to load BasicA after the prompt and got the error message, "You cannot run Basic as a child of Basic." Sounded rather mystical, and I could not find any explanation of the message.

I suspect the *shell* command does not wipe out BasicA in memory, unlike the *system* command, and expects that the program will return to the BasicA level again. Is this correct? Is *shell* a command in Microsoft Basic that has not been documented in IBM Basic? I would appreciate an explanation of *shell*, including some possible uses.

Santi Vibul

A: Yes, the *shell* command does not erase Basic from memory, and that is why you cannot simply reload Basic. When you use *shell* with something that leaves you in DOS (such as your batch file), you must use the *exit* statement to return to BasicA. This will prevent the "child of Basic" error message. The October "Q&A" column gives a brief explanation of the *shell* command and a hypothesis as to why it was not documented. Since it's not yet implemented correctly, its usefulness is very limited.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Q: I have come across two inconsistencies between the Basic interpreter and the Basic compiler when writing programs for IBM pc. Both differences deal with the tab key.

When you press the tab key in the interpreter mode, the cursor moves to the next tab position. In the compiled version pressing the tab key moves the cursor to the next tab position, but the characters that are tabbed over are cleared from the screen. In addition, the other cursor-positioning keys (that is, the arrows on the keypad) don't function. So to get to a field in the middle of a line you must rekey the data that precede the field you wish to get to.

The second inconsistency is that tab settings are off one position between interpreted and compiled Basic. I try to align my fields so that they begin at a tab setting.

I find both of these situations unacceptable and disturbing, and I'm curious why they exist and if there is a way to get around them.

Royce Rogge

A: You're right—you can't edit input statements in compiled Basic. This is a recognized deficiency and it is supposed to be corrected in future versions of the compiler. For now, here is a short program that may point you in the direction of correcting the destructive tabbing and the variation in tab size.

This program lets you use the F1 key as a tab key to tab nondestructively over characters to the correct field. However, you can't use F1 during an input statement. What you need to do is include a pause so that your users can hit F1 to tab to the correct field, trap another key for them to press to let you know they're finished tabbing, and then use the input statement for the data.

By setting the value of the variable Interpreter, you can have the tab size be either that of interpretive or compiled Basic. If you want tabs to be similar to compiled Basic, set Interpreter to 0; otherwise set it to 1.

```
10 A$ = "123456789 ": FOR I=1 TO 8: PRINT A$;: NEXT
20 TABSIZE = 10: INTERPRETER = 0
30 DEF FNTABB(COL) = INT(COL/TABSIZE+1)*TABSIZE
   + INTERPRETER
40 ON KEY(1) GOSUB 1000: KEY(1) ON
50 KEY(1) STOP: C = POS: PRINT "*";: LOCATE ,C,1:
   KEY(1) ON: GOTO 50
1000 LOCATE ,FNTABB(POS(0)): RETURN
```

Q: After six months of reading all the fine print in computer magazines (I subscribe to five!), I am blurry-eyed and defeated. After many hours and miles of slogging from one store to another asking question after question of salespeople who knew little more than I, I've given up. Bright idea—ask *Softalk.*

I have bought and installed both the monochrome adapter and the IBM color/graphics card. I have the monochrome monitor and an excellent color TV. I can make both hookups and already have the switch program written on my DOS disk. Now, who in the world makes an RF modulator that I can install on the little DIN connector on the color board? I do not need or want something that looks like an Atari game switch, or has its own transformer, or has to be hard-wired in place, or costs $70, for that matter. All I want is a solid-state device that plugs into the board on the connection IBM (in its infinite wisdom) has provided but will not support. Do you have any connections for these connections?

Ed Halley

A: M&R Enterprises in Santa Clara, California, used to make an RF modulator like the one you're describing, and it cost about $20. However, about a year ago the FCC banned this unit. Now, apparently, all that is available is the universal RF modulator that costs $70 and plugs into any composite jack. So now you can thank the FCC.

If you happen to have a VCR, you can use it as an RF modulator.

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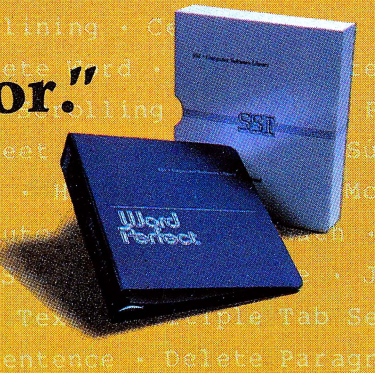

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Q: I have not had much experience with the the pc yet but am learning every day. I've been fascinated by the pc's music capabilities. I have read that you can produce polyphonic sounds on the pc's existing speaker, yet I have not seen any way to do this. Can you tell me how to do this?

My second question is easy, but you may not have the information to answer it. I own a pc at work but would like to have pc capabilities at home, too. Unfortunately, I can't afford to buy another pc. Do you have any information on the IBM Peanut? I have heard rumors that it will be coming out soon. Do you know of any features or configurations?

John M. Schoenberger

A: Playing polyphonic music can be done, but it's a fairly sophisticated programming project and cannot be done from Basic. You have to program at the machine level. Take each note of a chord and play it for a very short time (say one one-hundredth of a second) and then cycle through the notes of the chord so it sounds as if the notes are being played simultaneously. There is a program called *Keyboard Piano* (Europro, Box 390605, Mountain View, CA 94039) that converts the pc into a piano keyboard. You might contact them and see if their application supports polyphonic music.

We wish we could give you the scoop on the Peanut, but at this point we'd just be sharing rumors. After it's announced, if you have specific questions, just write and we should be able to get the information you need.

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Q: I ran the Scrollk.com program on my pc and it works perfectly. After that I followed your advice and entered it in an Autoexec.bat file and it worked correctly. The problems I am having are not with the scroll program but with batch processing and working with the Autoexec.bat file.

First, if I enter any DOS 1.1 command after Scrollk.com, the automatic execution stops running after Scrollk, and DOS displays the A> prompt. This occurs only after Scrollk. If I enter *scrollk basica menu*, DOS runs Scrollk and stops there, but then if I enter *basica menu*, it runs perfectly.

Second, I use a menu program that uses the *inkey* command as input. During the *inkey* time I run the clock on my display. This program ran perfectly until I ran it in an Autoexec.bat file. The problem is that while running the portion of the program with the *inkey* and *time* commands, you can see traces of the cursor going on and off on the display. I understand why (because of the repetitive movement of the cursor on the screen) but if I make a break in the program (control-break) and run it again immediately, it runs with no trace of the cursor. This only occurs when the program is executed in the Autoexec.bat file; if I run it manually, traces of the cursor never appear.

Henry Balaban

A: Your first problem may occur if you have *scrollk, basica,* and *menu* on the same line. If that is the case, DOS interprets *basica* and *menu* as arguments for the Scrollk program. When it finishes running Scrollk, it goes to the next line, finds the end of file marker, and returns you to DOS. To correct this, put *basica* menu on a separate line.

Your second problem is more difficult to solve. You might try putting the line

```
LOCATE ,,0
```

following the line in your program where you print the time. This will turn off the cursor until your next *locate* statement. You can turn the cursor back on with a *locate ,,1* statement. Let us know if this works. If not, we'll do some more digging.

Q: Perhaps I am asking too much of our IBM pc, but someone out there must have some ideas. In my business I need to calculate cross-sectional areas of irregular shapes. I would like to trace a drawing ten times the size of these shapes, get a display on the monitor, and then a calculation of the cross-sectional area. Knowing what a cubic inch of rubber weighs, I can then calculate the weight per thousand feet that is the base for our pricing.

Maybe a light pen, a mouse, or a more sophisticated "draw" program is available that would do what I want. I would appreciate help from anyone.

Terry E. Starr

A: There are a couple of programs that will do some of what you want. One is called *The Drawing Processor* (BG Graphics, 824 Stetson Avenue, Kent, WA 98301); you could use it and a digitizer tablet to draw two-dimensional figures, and it will calculate the area of a closed figure. It won't, however, do three-dimensional volume calculations. They plan to have a program to do these calculations, and it will be available by the end of the year.

With the program *Computer Aided Design* (MicroCAD, 764 Twenty-fourth Avenue, San Francisco, CA 94121), you can use a digitizer tablet or mouse to trace three-dimensional figures; however, at this point you would have to write your own program to calculate the area. The points of your drawing are stored in an easily accessible database so this would not be too difficult to do. MicroCAD plans to have a program out by the end of the year that will calculate volume, area, and cross-sectional properties. They claim that their program is well-known and users have had good success with it. ▲

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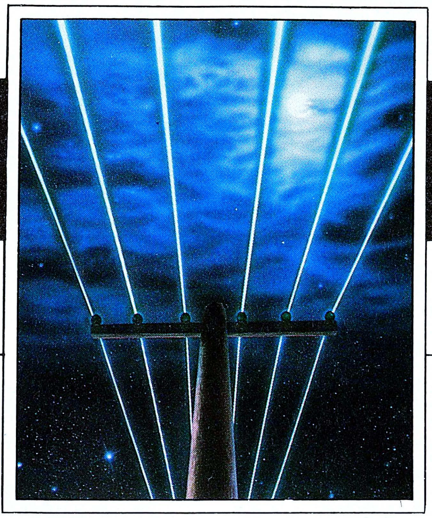

COMM LINES

by Kevin Goldstein

Hardware Choices—a Buyer's Guide

If you've followed this column to this point, you should have a pretty good understanding of why a modem is needed, how it works, what it does, and—just as important—what it doesn't do. That should put you one giant step ahead of almost everyone else in the computer business, because, of all the black boxes you'll likely run into, modems appear to be particularly mysterious. But, in a sense, everything we've covered so far is prelude to the important stuff—choosing the right modem, matching it to the right software, connecting the modem, troubleshooting the whole shebang, and then getting some useful work done. That "introduction" is going to prove very useful, however; it will make it easier for you now to wade your way through the advertising and buy the right equipment.

The place we'll start is the same place you'll start if you decide to add a comm line to your pc: choosing the hardware. We won't review all the available hardware here, nor is that even necessary; we'll simply point out some of the factors to consider when setting up your own comm link.

One of the first questions to ponder is, what kind of modem should you buy? As earlier installments of this column have suggested, modems run the gamut from inexpensive boxes with minimal features to high-performance, fully featured, very expensive boxes.

With but a few exceptions, all the modems you will look at are capable of operating at up to either 300 baud or 1200 baud, with 1200 baud being the affordable state of the art for personal computers.

It is possible, of course, to get higher-performance modems, but unless you intend to do an incredible amount of long-distance telecommunicating, you'd likely spend more money buying the higher performance than you would save on communications charges. Even if money means nothing to you, remember that modems need to operate in pairs. It's less than useless to buy a 9600-baud synchronous modem if everybody you want to communicate with is using 1200 baud. Since 300/1200-baud links are almost universal in the world of personal computers, the implication is that you would want to consider getting a higher-performance modem only if you were specifying the equipment at both ends of the line. And even then that would pay only if you were going to send a lot of data each month.

If you find yourself in this situation, it's time to fire up the spreadsheet and figure a few "what ifs." The first variable is, of course, the price of the modem. Above about 1200 (or now, in a few cases, 2400) baud, the price of telecommunications gear seems to rise exponentially with the unit's speed. Even so, it's not hard to amortize the cost of expensive gear over the life span of the equipment; unlike a car, communications gear tends to last a while. The trickier variable is the cost of the phone line itself. As noted in earlier installments, the standard dial phone line—called a *direct distance dial line*, or DDD—is not capable of supporting full-duplex data transmission beyond about 1200 baud. (Some companies are just now starting to offer modems that can run at up to 2400 baud on a DDD line; but because of the trickery necessary to achieve that speed on a standard line, these devices are also quite expensive.) To get more speed you must rent what is known as a *conditioned line*, a line that gets special treatment from the phone company to extend its bandwidth. Conditioned lines bypass some or all of the switching equipment normally used to route a call from its source, through the myriad phone lines, to its destination. This switching equipment is the source of both noise and bandwidth restrictions, so conditioned (sometimes called dedicated) lines can operate at higher speeds than DDD lines.

Conditioned lines come in many flavors, but they share one characteristic: They carry a far higher monthly rental than standard dial lines. Your "what ifs" will have to balance this higher monthly charge against the time charges of a standard dial line. Unless you have a lot of data to send on a regular basis, you are unlikely to realize any savings with a conditioned line.

If you nonetheless still feel the need for a higher performance comm link, you might consider a half-duplex line. A half-duplex link lets data travel only one way at a time; to receive data, you've first got to stop sending data. After data is transmitted, a certain amount of time is required to let the line "quiet down" before data can be received on a half-duplex line; this delay time is called *line turnaround.* On a line that's being used for interactive communication, this combination of being able to send only one way at a time and the extra penalty of line turnaround makes half-duplex links both annoying and inefficient. However, if most of what you are doing is downloading or uploading long files, half-duplex links can be fairly efficient and are worth considering.

As of now, the comm link that you'll run across most often is 300-baud asynchronous. Twelve-hundred-baud modems were pretty rare in the world of personal computers until fairly recently, so if all you want is the occasional ability to communicate with whomever whenever, you can't go far wrong with a 300-baud link. It's true that 1200-baud lines are rapidly becoming more common, but most such lines support 300-baud operation equally well. As a case in point, you'll find that most public bulletin boards that now support 1200-baud operation automatically adapt to 300 baud when required; in the worst case you'll simply have to dial a different number.

Thus if your communications requirements are not excessively heavy, or your pocketbook is a little light, a 300-baud line should serve you well. If you can survive without such fancy features as automatic dialing, you can find some very good bargains.

One thing to consider when buying a bargain modem is whether it can be used in both the answer mode and receive mode. Recall that a full-duplex modem uses two pairs of frequencies for data transmission. The modem placing the call, called the *originating modem*, grabs one of those pairs and uses it to send all its data. Let's say that pair of frequencies is 1070 and 1270 Hz (called the low band). If the modem that placed the call is transmitting on the low band, then the modem receiving the call, called the *answer modem*, must be receiving on the low band. The answer modem must then use the high band to transmit data, while the originating modem receives its data on the high band (2025 and 2225 Hz).

Now, what happens if everybody hangs up, and the modem that was receiving the call—let's call it modem B—now places the call? Since it's originating the call, modem B will now grab the low band and use it to transmit on, meaning that modem A must now transmit on the high band. But that's just the opposite of what happened before: B is now transmitting on the frequency it was receiving on before—and vice versa.

Most of the modems you will see advertised are billed as "originate/answer" modems, which means they are capable of transmitting on either the high or the low band, depending on whether they are originating or answering the call. A modem advertised as "originate only" can transmit only on the low band, and thus you cannot use it to answer a call from another modem; likewise an "answer only" modem cannot be used to place a call. The difference in price between originate (or answer) only modems and originate/answer modems is fairly small, so there's no particular reason to get stuck with an originate-only or answer-only modem.

On the other hand, some originate/answer modems can automatically switch to the proper mode, while others require you to set a switch telling the modem whether you will be answering or originating a call. Here's a feature on which you can save money (by not getting it), because while the automatic switchover is nice, it doesn't let you do anything that you couldn't already do anyway.

At the high end of low-priced 300-baud modems are those that can detect the ringing of the telephone and answer automatically. Such auto-answer modems allow unattended operation, a feature that can save you (or, more correctly, the calling party) money. For example, if your friend wanted to send you a very long file, you could tell her to send it after 11 p.m., when the phone rates drop appreciably; just set your auto-answer modem, go to sleep, and the file will (you hope) be waiting for you in the morning. (You will, of course, need appropriate software, but that's another story.)

If you will be doing a fair amount of telecommunicating, and you can afford it, consider getting a 1200-baud modem. While 1200-baud modems cost in the range of two to three times as much as 300-baud modems, they reduce the time required to send data, so your phone bill will drop commensurately.

Most of the information sources, such as the Source or CompuServe, now offer 1200-baud link-ups. You'll pay a premium to access an information service over a high-speed link—perhaps two to two and a half times what a low-speed (300-baud) link would cost. On the other hand, you'll be passing data at four times the rate, so you can save money.

Most of the 1200-baud modems advertised for personal computers conform to what is known as the Bell 212A standard. Like the Bell 103 standard, the 212A standard is a full-duplex, asynchronous protocol. Beware of modems advertised as Bell 202-compatible; the 202 protocol is an older half-duplex standard, incompatible with the popular high-speed modems now being offered by companies such as Hayes and Novation.

From the user's point of view, the 212A standard is simply a speeded-up version of our old faithful 103 standard, which, you'll recall, was good only up to 300 baud. Technically speaking, however, a 212A modem is a good deal different from a 103 modem.

While a 212A modem accepts data from and sends data to the computer asynchronously, it actually transmits that data over the phone line synchronously! If you could "listen" to the phone line, you'd discover that the frequencies employed by 212A modems are also different: 1200 Hz for the low band, and 2400 Hz for the high band. Even the transmission method is different, with 212A modems using what is known as synchronous, dibit,

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phase-shift keying. We won't get into synchronous modems in detail here, but (briefly):

Synchronous means that, rather than using start and stop bits to frame (distinguish) each character, a modem sends a continuous string of bits; the modems at each end count the bits to determine where one character stops and the next begins.

Dibit means that, rather than being encoded separately as either high or low frequencies, the bits are grouped in pairs; each pair is transmitted as one of four possibilities. The fact that the bits are grouped in pairs means that the data rate on the line is half the data rate into or out of the computer. To indicate that the bit rate on the phone line is different from the data rate, a new term was dreamed up. That term, as you may have guessed by now, is *baud rate.* The baud rate is the information rate, which in this case is half the bit rate. Being perfectly accurate, a modem using dibit encoding is transmitting data over the phone line at 1200 bits per second, or 600 baud. Looking at the connection between the computer and the modem, however, both the baud rate and the bit rate are equal—1200.

Phase-shift keying means that rather than switching between two distinct frequencies to represent a 0 or a 1, a modem "slips" a single frequency forward or backward in time with respect to some reference clock. We'll examine later just what this means.

The reason we're not going into detail here on the differences in the signaling schemes between 103 and 212A modems is that, to the computer, both schemes are made to look identical. The transformations that a 212A modem makes to the data—asynchronous to synchronous conversion and dibit encoding, for example—are done transparently; the modem at the far end simply undoes what the near-end modem did. But knowing this much about it should give you an idea of just why 1200-baud modems are so much more expensive than 300-baud devices.

Since the signaling schemes used by 1200-baud modems are so different from those used by 300-baud modems, you might be wondering about those ads for modems that can run at either 300 or 1200 baud. And right you would be to wonder: a Bell 212A modem cannot talk to a 300-baud modem. The manufacturers offering such modems take the most direct way around the problem: They simply pack the equivalent of two modems into a single box. That's why you'll frequently see such modems advertised as dual modems—they truly do have the guts of two modems inside.

Just as buying an audio receiver with integrated preamp, amp, and tuner is less expensive than buying those three components separately, so packing two modems into a single box is cheaper than buying two separate modems. Many of the components—from the physical packaging to the power supply and even the electrical interface to the computer (the RS-232 interface)—can be shared.

That sharing is also why you can't establish two simultaneous comm links with a dual modem. When running at 1200 baud, for example, the 212A-compatible circuitry uses the RS-232 interface; at 300 baud, the interface is switched electronically to the 103-type modem. But the sharing also offers an advantage: Because the shared circuitry is switched between the two modems electronically, it is a fairly simple matter to add a little extra circuitry that can automatically detect which type of signal a calling modem is putting out, and switch to that. For complete speed transparency, the UART (universal asynchronous receiver/transmitter; see last month's installment of this column for more about UARTs) within the computer must also be capable of detecting and automatically adapting to the proper speed.

As long as we're on the subject, let's note one important difference between a 103-type modem and a 212A-type modem. Recall that a 103 modem doesn't know or understand anything about characters; it simply encodes each bit as it is sent from the UART. Asynchronous

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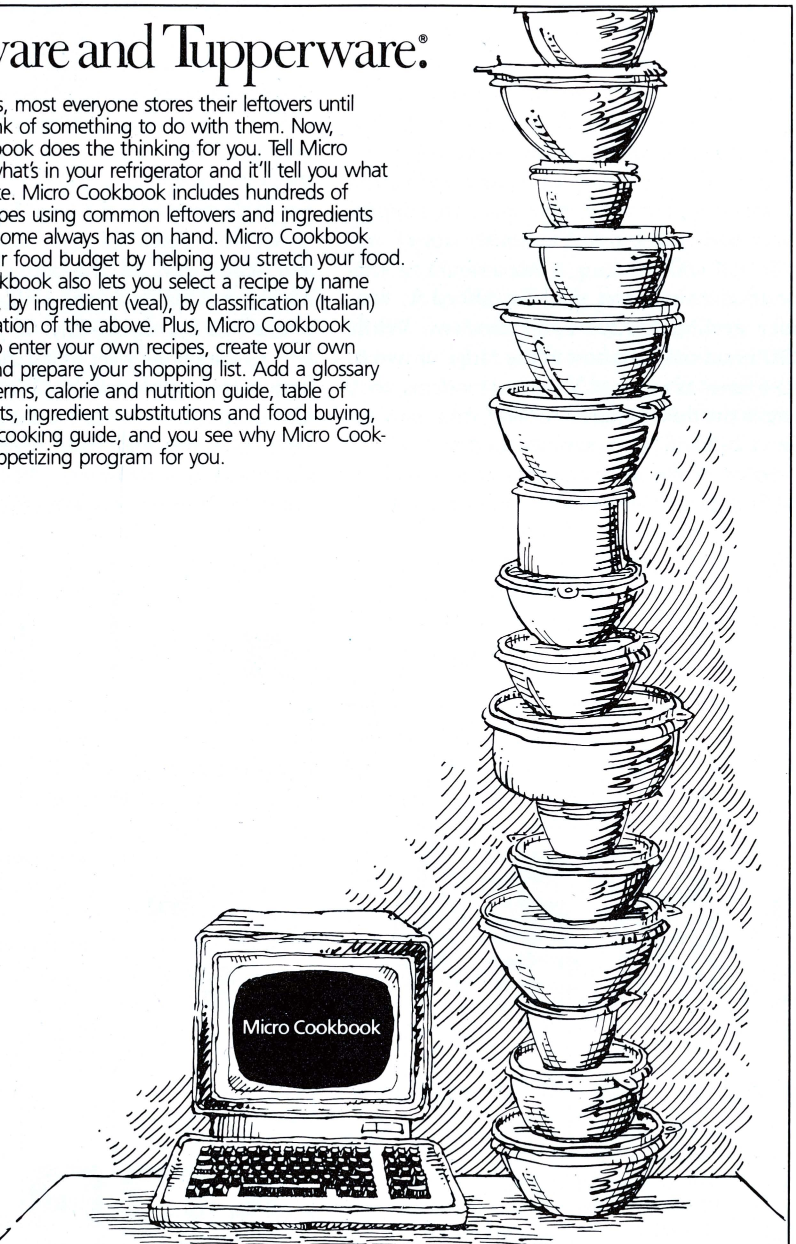

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modems have no internal clocks for determining the bit rate—and don't need any; that's why you can use a 103 modem at virtually any speed up to and including its maximum rate of 300 baud. Change the UART's clock from, say, 110 baud (Teletype rate) to 300 baud and the modem works just fine. Synchronous modems, on the other hand, do have internal clocks; a synchronous modem can be run only at the rate for which it was designed. Although 212A modems look to the outside world as if they were asynch, they really operate, as we have seen, synchronously. It follows, then, that 212A modems can operate only at the data rate for which they were designed, 1200 baud. Put a 900-bit-per-second data stream into a 212A modem and you'll get garbage out (if you get anything at all).

By now you can see that you're getting a whole lot of hardware for the money when you buy a 1200-baud modem. If you're looking for maximum flexibility in a high-speed modem, concentrate your search on dual modems, such as the ones discussed above; that way you'll be compatible with almost anything you'll likely encounter in the world of personal computers. Almost without exception, such modems will also be originate/answer modems, capable of both placing and receiving calls, and will you give you maximum utility for your money.

If your pockets are deep enough, you may wish to consider some of the fancy options. Depending on your intended use, automatic answer may be a valuable feature to look for; if you decide to get a modem with auto-answer capabilities, you will have to decide whether you also want auto-speed selection—that is, the ability to switch between 103 operation and 212 operation as required.

Finally, if you really want to go whole hog, you might get a modem that offers auto-dialing capabilities. As noted earlier, auto-dialing is not, technically speaking, a modem function; as a matter of fact, until relatively recently, auto-dialers were available only as separate boxes that connected via their own cables to separate I/O ports. The combination of auto-dialer and modem in the same box offers certain economies, however, and has thus become a very popular feature.

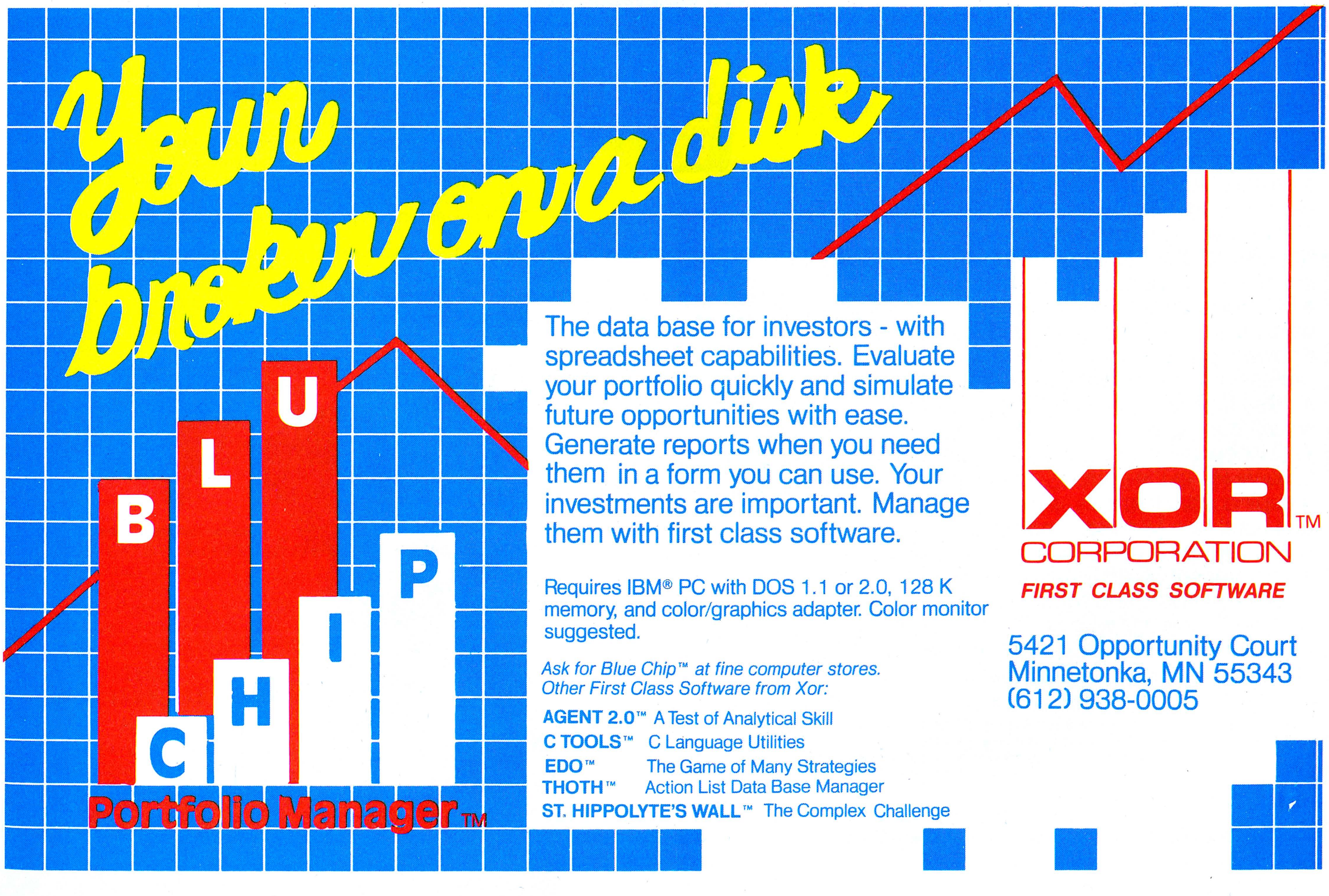
By the time you reach the level of 300/1200-baud dual-modems with auto-dialing, you're talking about a relatively expensive device (around $500), and manufacturers seem unable to resist the temptation to throw in all kinds of fancy programmability to support the dialing and other bells and whistles. It's probably not a good idea to be too overawed by the programming possibilities: For the most part it's easier to do the programming in the computer. (You do need the basic hardware, however: auto-dial, auto-answer, auto-speed-select, and, in the case of the 1200-baud modem, programmable data format.)

Before we conclude this buyer's guide to modems, one more option needs to be considered: Do you want a modem that sits on a card that plugs into your pc, or is a black box that sits on the desk better?

The answer depends on the exact configuration of your machine and, in particular, on how many free card slots you have. If your pc is already crammed to the gills and you have an unused communications port or three sitting idle on a combo card, an external box is the way to go. Besides not consuming a slot, a standalone modem can offer the additional advantage of monitoring important interface lines via LEDs: Actually seeing the "carrier detect" LED lit is a reassuring sign that your dog hasn't bitten through the phone line. And although it's unnecessary to watch the receive data light blink on and off as your pc receives a file, it does give you something to do.

On the other hand, if you have some spare slots, you can save a little money by getting a single-board modem. An "in-the-pc" modem saves space and reduces the spaghetti of cables behind your machine; and many such single-board modems come with a communications port right on the board. That saves you the bucks you would otherwise spend buying a separate communications port board.

Next month we'll look at some of the intricacies of installing communications gear. ▲



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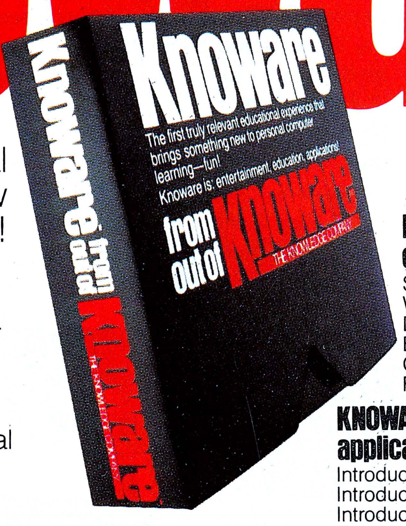
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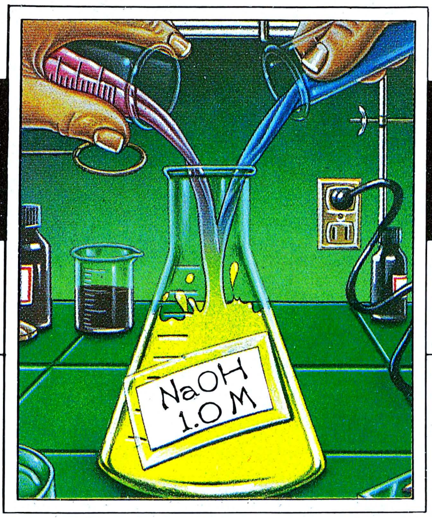

by Joe Juhasz

Coping with the Garbage Collector, Part 2

As last month's column pointed out, there are two approaches to minimizing the effects of the Basic interpreter's garbage collection. The first strategy is to reduce or eliminate string space fragmentation. The second is to reduce the amount of time required for the interpreter to collect the garbage.

The two most powerful tools in your fight against garbage collection, the *lset* and *rset* commands, were introduced last month. This month we'll concentrate on *mid$*, your third weapon. The reason why the *mid$* function is an anti-garbage-collection agent is that it reuses already allocated string storage space, rather than causing the allocation of new storage and the consequent fragmentation of string storage space.

Let's look at an example. The statement

```
10 I$ = "abcde"
```

causes the interpreter to set aside five bytes of storage for the variable I$. You can envision that storage looking like this:

```
| a | b | c | d | e |
```

The subsequent statement

```
20 MID$(I$,2,3) = "234"
```

moves three characters into I$'s storage space, without consuming any new storage area. After this statement, the same five bytes of memory look like this:

```
| a | 2 | 3 | 4 | e |
```

Putting Mid$ to Use. Dates can be stored in many ways. One popular way is in the format YY-MM-DD. This format is convenient for sorting purposes, since it orders the largest time unit first and the smallest last. But it isn't the way we're accustomed to looking at dates. People in this country like to see dates written MM-DD-YY.

Examine the following two ways to convert dates from the YY-MM-DD format to MM-DD-YY. *Print fre(0)* statements have been included in each example, so you can see the garbage ramifications of each of these methods.

After you enter the code, you can run the first method by entering

```
RUN 1000
```

Notice when you do that each format conversion eats up twenty-one bytes of storage.

You can run the second method by typing

```
RUN 2000
```

Notice that by using the *mid$* function you avoid fragmenting the string storage area.

Swap. Another useful tool in the battle against garbage collection is *swap*. The statement *swap A$,B$* causes the values of A$ and B$ to be exchanged. Basic merely switches the address and length information

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This text was produced using WordStar, a dot matrix (Prowriter) printer, and DDPLUS.

```
1000 'METHOD #1:
    1010   '
    1020   YYMMDD$="83-09-15"      'yy-mm-dd format
    1030   '
1040 'convert
    1050   MMDDYY$=RIGHT$(YYMMDD$,5)+"-"+LEFT$(YYMMDD$,2)
    1060   PRINT YYMMDD$;" <=> "; MMDDYY$;FRE(0)
    1070   SOUND 32767,18*1: SOUND 32767,1   '-pause for 1 second
1080 GOTO 1040
1090  '
1100 '<============================>
1110  '
2000 'METHOD #2 (uses MID$ function to avoid storage fragmentation):
    2010
    2020   YYMMDD$="83-09-15"  'yy-mm-dd format
    2030   MMDDYY$="xx-xx-xx"  'must give NEW$ length of 8, also dashes
    2040   '
2050 'convert
    2060   MID$(MMDDYY$,1,5)=MID$(YYMMDD$,4,5)
    2070   MID$(MMDDYY$,7,2)=LEFT$(YYMMDD$,2)
    2080   PRINT YYMMDD$;" <=> "; MMDDYY$;FRE(0)
    2090   SOUND 32767,18*1: SOUND 32767,1   '-pause for 1 second
2100 GOTO 2050
```

associated with each variable. No new storage is allocated, and therefore no storage fragmentation occurs.

This method of exchanging string variable data is preferable to

TMP$ = A$: A$ = B$: B$ = TMP$

because the latter method causes many bytes of storage to be used up.

Storage fragmentation can even be caused by certain *print* statements. For example, *print "DATE=" + Date$* causes storage fragmentation, while *print "DATE="; Date$* does not. The moral here is to avoid the concatenation of strings whenever possible.

How To Shorten the Collection Time. A number of factors together determine the length of time needed by Basic to complete its cleanup work. Strangely enough, the amount of garbage (fragmented storage) is not one of these factors.

The relevant factors are the amount of storage, the number of string variables, and (most important) the number of string variable array elements. Eliminate string variable arrays from your programs and you will reduce the time they spend in garbage collection to nearly zero.

Some string arrays cannot be eliminated, but many can. For example, many string arrays can be replaced by numeric arrays. Zip codes should be stored in a single-precision array, not as strings, and state names can be stored as numbers representing states.

The use of these techniques, as well as those presented last month, will keep your programs free of lengthy housekeeping delays. Some thought and care during the design phase of your programming effort will result in smoother, faster-running programs.

Next Month. In medium-resolution graphics mode on the IBM pc, you are normally limited to forty characters per line by the print statement. In high-resolution mode, you have eighty columns of smaller text per line. Next month's column will offer techniques for displaying both text sizes in either resolution graphics mode. ▲

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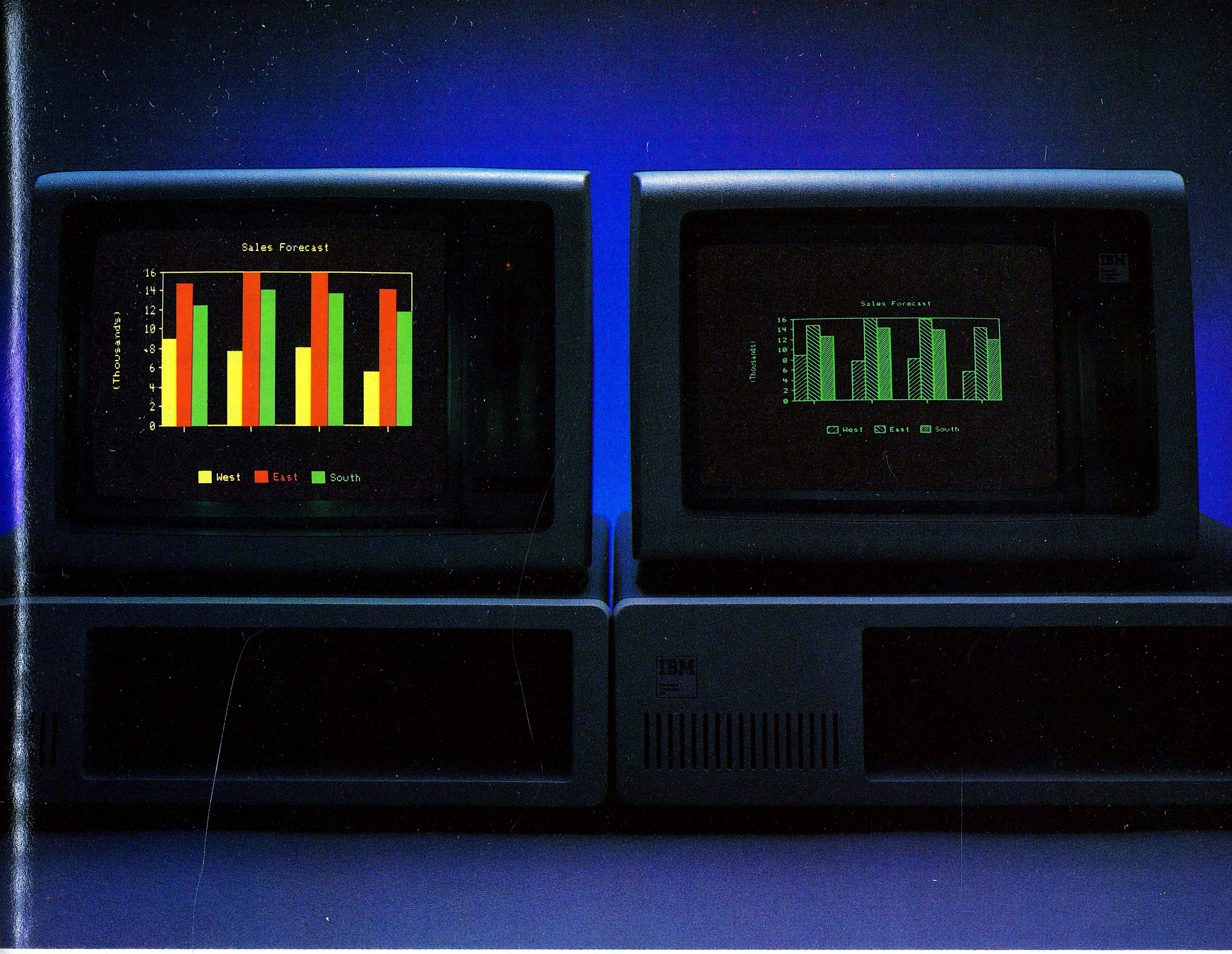

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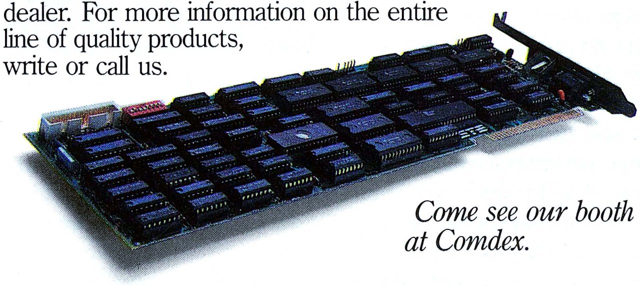

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In the latter half of 1981, the two longtime friends decided to join forces to produce and market peripherals for the Apple II. Farris also had in mind a computer terminal he wanted to manufacture that would feature a screen capable of displaying a spreadsheet, graphic chart, and the text of a letter—all at once.

But in November of that year, plans would change. For it was then that Strange and Farris had the opportunity to examine a new computer that would, like the Apple, revolutionize an industry. The computer, of course, was the IBM pc. As they walked out to their car after the demonstration, Farris told Strange what he hoped to do. "I think I can make some boards for this," he said simply.

It was just the kind of thing Strange, an entrepreneur and college-level marketing teacher, wanted to hear. And by day's end, with *Technical Reference* manual in hand, Farris was already at work designing a plug-in board that would add 192K of memory to the pc's 64K.

The men who founded Quadram—Leland Strange(left), now president of Intelligent Systems Corp., and Tim Farris (right), president of Quadram.

By the end of the year, the board was in production and for sale, even though the twosome did not yet own a pc. Borrowing one from a friend, they tested their boards at night and on weekends.

The boards worked, and the partners followed up with enhancements designed to please both hacker and neophyte. A quartz calendar/clock was one option, a spooler was another, and serial and parallel ports were other needed items. Those products, too, worked and worked well. Then came the idea to combine all four options on one board—freeing up expansion slots, giving retailers a powerful "extra" to sell, and offering the consumer an all-in-one option.

A Board for All Seasons. Thus was born the Quadboard, Leland Strange recalled recently. And thus was born a company, Quadram, based in Norcross, Georgia.

For Strange and Farris, nearly overnight success has meant becoming multimillionaires; for Atlanta (of which Norcross is a suburb), the firm has meant new jobs—250 of them at the two-year-old company and dozens more with nearby suppliers. And for the pc user, Quadram has meant a range of peripherals, including a new board that allows the by Mark Kellner

MULTIFUNCTION

A concern for both Strange and Quadram general manager Otis Jones (left) is managing the company's breakneck growth.

pc to run Apple II software, virtually creating two computers under the same hood.

"But," says Otis Jones, longstanding friend of Strange and Farris and now general manager of Quadram, "you don't ride one horse to death; you find other winners." In keeping with this view, Quadram today manufactures a host of products for the pc and other computers. In one brainstorming session, Farris and Strange reportedly came up with ideas for thirty different salable enhancements. In addition, Quadram's parent company, one-third owned by the two founding Georgians, has launched a software division that concentrates on new products for the pc. Two financial planning programs are already on the market (see accompanying article, page 36).

Consider: a homegrown operation that sold twelve million dollars' worth of product in 1982, that is conservatively projecting $50 million in sales for this year, predicting a tenfold increase in personnel in as many months, and that's moving into a sixty-thousand-square-foot building one year after the five-thousand-square-foot plant believed adequate for five years had already been supplanted four times. To Strange, Farris, and Jones, this rapid growth is just part of a corporate triumph—the management of breakneck growth.

"Our biggest challenge has been managing all this success," Strange says, and, looking around to see workmen finishing the landscaping and front-office staffers scrambling for color boards and cables, a visitor is inclined to believe him.

"Obviously, we knew that we would be successful," he adds, "but we thought that it would take us five years to get where we are in two. The rapid increase in IBM pc sales has contributed to the growth of the company."

But sales of IBM-related peripherals account for only about half of Quadram's business, according to Strange. In late spring, sales of the company's Microfazer printer buffer, which frees up a computer for other tasks while a printer outputs files, constituted 25 percent of the company's sales volume.

Georgia's Own. Strange and Farris are both natives of the Peach state and members of the same Southern Baptist church—Duluth Baptist, located in an Atlanta suburb.

Before Quadram came to be, Strange was busy serving his computer store customers and Farris was involved in computer engineering. As Strange's computer business grew, he realized that he needed a special kind of technical help; his Apple customers were seeking enhancements that weren't commercially available. That's where Farris entered the picture: to build the unavailable.

"Originally," says Strange, "we'd help each other at my kitchen table or on his back porch. One day Tim came to me and said, 'Let's do this together.' "

That happened at about the time the two men inspected the pc, and Farris had the notion that he "could" build boards for it. The memory expansion board was popular and so were the port, clock, and printer add-on boards. Then came the decision to combine the four products, and with it the question of how to market them.

"We were not the first to have a multifunction board, but we were the first to tell the world about it in a meaningful way," Strange recalls. "If you think back to January or February of 1982, there were few people using four-color ads, and nobody was using four-color spreads. We were the first to devote two full pages to a board and to illustrate it."

That strategy found critics in the marketplace, people who said it was benefits that should be sold and that the board might never be seen by the end user, certainly not after it was installed.

"I taught marketing, so I understand the critics who said, 'Sell benefits,' " says Strange. "But the industry was ready for something different. You don't just have to communicate; you have to communicate properly."

The marketing professor did several innovative things besides using ad space and color lavishly. He chose a typeface that was substantial-looking and spoke about a "tradition of quality," which, while true, was an unusual thing for a then-six-month-old company to claim.

The ads worked. "I used to smile when people would call us and say, 'I know you; I've dealt with Quadram for years,' " says Strange.

"We were also the first to put a board in a consumer box, the first to shrink-wrap it," he adds. "We knew the box would be thrown away, but it made a statement about the company that we had the volume to do that kind of packaging. It differentiated us from a garage operation."

Strange also smiles while he recalls one headline that said Quadram "sold boards like soap." That writer's comparison was not too far off, he notes.

"We have product managers who watch each market," he explains. "A board can be considered a commodity. If you don't add value, a board sells at a low cost. Some of the value we add is in features, some is in support and documentation. And that's not fluff—it's important to consumers."

Future Stock. Also important to consumers are future products, and the company is actively working on some right now. Top-priority items include hardware and software for networking and a two-megabyte RAM add-on that will enable users to run such programs as *VisiCalc* and *1-2-3* even faster than they can be run on a hard disk.

Quadram is also considering the possibility of making multifunction boards for other computers, as well as determining which boards are compatible with pc "clones," such as the Compaq, which accepts Quadlink with a minor cable modification.

"We're not going to be an OEM manufacturer," says Farris. Instead, he clarifies, the company is going to help consumers "put it all together" by making peripherals. And they're "trying to pick winners" in the burgeoning computer market.

IBM's pc is obviously one of those winners. So is Apple, with more than seven hundred fifty thousand units sold. Two other brands Farris is impressed with are the Compaq and the Victor; the latter is big in Europe, he says. Farris is also optimistic about new markets for computers. "Today, personal computers are primarily for small business systems, so we'll look next at the home market," says Farris, making reference to IBM's forthcoming Peanut, rumored to have 64K and a $500-to-$1,000 price tag.

Strange concurs, saying that if Quadram's boards can be installed directly, the firm may offer an expansion box designed to complement the Peanut. "We don't know what features will be there, but we'll be on the scene."

An Exercise in Faith

Comdex, which was held this spring in Atlanta, can be a show of sameness. Exhibit after exhibit, party after party, hospitality suite after hospitality suite—all geared toward enhancing images and bottom lines. And while Quadram was there, had an exhibit booth, and was hospitable to many, the company's graciousness took a different form. Instead of having a cocktail party, Quadram sponsored a prayer breakfast and invited Norman Vincent Peale to speak.

The marriage of the power of positive thinking to dynamic memory chips is not as far-fetched as it might sound. Quadram founders Leland Strange and Tim Farris and general manager Otis Jones are all "born-again" Christians and members of the same Southern Baptist church.

Strange and Farris decided early on to tithe the company's profits, giving 10 percent to Christian work. Now that the firm is part of a publicly held company, the tithing has been supplanted by a stock transfer to the Quadram Christian Foundation, the formal sponsor of the prayer breakfast and maker of heretofore unpublicized donations. Jones is the foundation's president.

Jones, who came to Quadram after working "sixteen years and four months" for IBM's general systems division, prayed for two weeks before signing on with the new firm. His faith finds plenty of exercise in the company, where his greatest concern is "quality in products, people, principles, and service." The prayer breakfast "lets people know what we stand for," Jones says. After the Atlanta event, he reports, "the firm received letters from store owners and competitors, praising the breakfast. There was no negative feedback."

The Quadram Christian Foundation screens requests for aid through its board of directors. So far, the foundation has helped pay off the debts of a family, so that the husband and father could feel free to enter the ministry. It has also helped a church in the Northeast make a mortgage payment. "Until now," says Jones, "the group has not publicized its work. The family that was helped doesn't know who its benefactors are."

"We're not zealots," Strange explains. "I hope our example will speak for itself." Strange is especially pleased by the venture capital deal negotiated before Quadram was acquired by Intelligent Systems Corporation. The deal was structured to allow Quadram to continue its tithing policy.

"We got three of the biggest venture capital funds to agree to this," Strange recalls proudly. "It was the first time they'd ever heard of such a thing."

But the company's Christian principles are not limited to a distribution of profits and sponsoring prayer breakfasts. Last March, Quadram cut prices on its Quadboard and then made the decision to credit or refund money to dealers who had boards in stock. The move cost the firm $500,000 and depressed ISC's earnings for that quarter, but Strange felt it was the company's responsibility to its dealers.

"The cost didn't matter," he says. "For the long term it was the right thing to do." ▲

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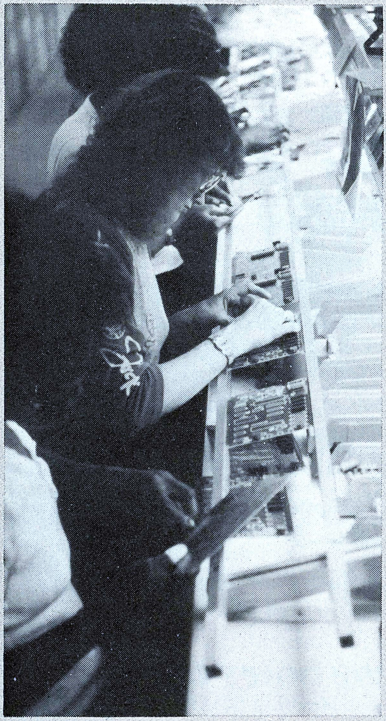
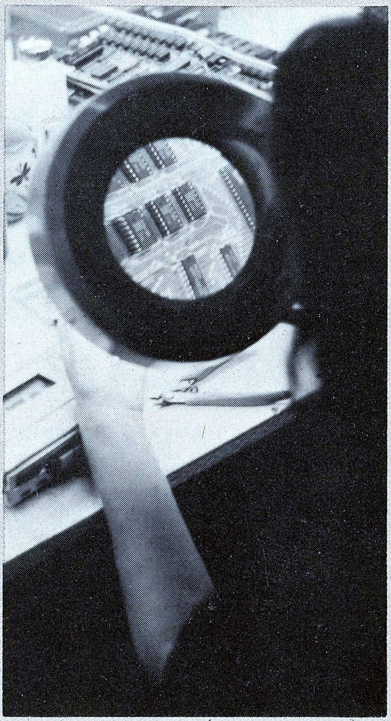
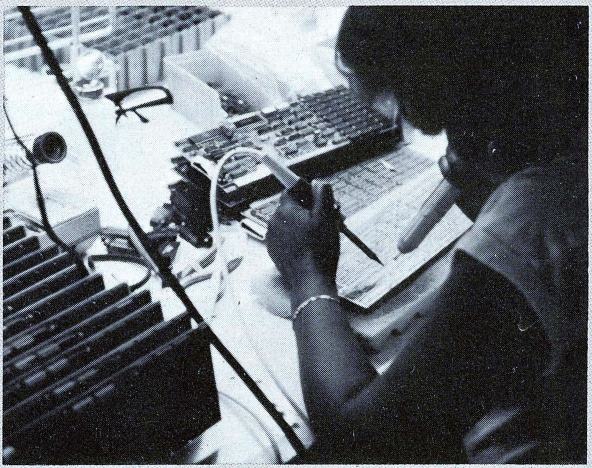
Going by the Boards







Quadram's bread and butter, various function boards for the pc and other machines, are assembled in the company's Norcross, Georgia plant. (Far left) The all-important chips are first located on the boards for positioning, then later soldered in place. After soldering, a technician (center) checks the boards and chips for positioning and possible flaws or defects. After inspection, spot soldering (above) takes care of any missed spots or weak connections.

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Quadram's future took on an even brighter cast last December, when the company merged with Intelligent Systems Corporation, a ten-year-old computer company specializing in color graphics applications for business. Quadram had been looking for venture capital, and it found the resources it needed when ISC, where Farris once had worked, came knocking.

At first the entrepreneurs turned ISC's offer down, but then they reconsidered and agreed, making Farris part owner of his former employer ("something I'd never thought of") and setting the stage for a reorganization of ISC that would see Strange assume the role of company president.

The man who was president of the company before the merger decided to resign after it took place, Strange recalls, noting that the man "saw that we did things differently." The greatest difference between the two was reflected in Quadram's aggressive stance, something ISC had lost in recent years. Strange was elected ISC president in March of this year, although he still spends 40 to 50 percent of his time at Quadram.

ISC is now a holding company, of which Quadram is one division. ISC's color graphics operations now trade under the name Intercolor, and the new firm is using the Quadchrome monitor for one product and the Quadcolor board for another. According to Strange, such "cross-pollination" between the two companies will continue.

Besides sponsoring new ventures, Quadram is becoming a quasi-distributor of other products or, as Strange puts it, the firm is going to be "a manufacturer that operates like a distributor." Among the products Quadram may market in the future are printers and hard disk drives; results are due at Comdex (at the end of this month, in Las Vegas).

"We're gonna be here for the long term," declares Strange. "One reason for the merger with ISC was to ensure longevity for Quadram. Our difference is a broad line. If we look at our competition, one has only buffers, another only boards.

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XQ—New Venture for Quadram's Parent Company

Marrying the skill of an accountant to the dedication of a programmer, Richard Prather, C.P.A. and computer buff, recently developed two programs for use by financial planners and sophisticated investors. Those programs caught the eye of Leland Strange, cofounder of Quadram and now president of Quadram's holding company, Intelligent Systems. Strange gave Prather the wherewithal to start XQ Software, a firm that will market the programs.

Prather describes his programs as "the next generation above home accounting programs." The *Tax Strategist* and the *Investment Strategist* are intended for people in the $40,000-and-up income bracket who want to figure out how much of a tax-shelter loss they need in order to hit a certain tax level and then to analyze which tax shelters are best for that target.

According to Prather, the *Investment Strategist* will analyze tax shelters for a period of up to fifteen years and calculate results, including internal rates of return, adjusted rate of return, direct benefits, interest on reinvested benefits, after-tax proceeds of sale, and future value of the contribution if put into a savings account instead of the tax shelter. As far as Prather knows, this kind of analysis is not available on any other commercial programs.

Prather, a former staff accountant with Touche, Ross, and Company, who also worked with MSA Software before starting XQ, says forty million Americans have incomes in that forty-thousand-a-year-and-up range. He feels that all of them could benefit from programs like these.

Since last fall, Prather's programs have been beta-tested by a small group of financial planners—a new breed of money managers who advise upper-income people about shelters and investments, as well as about tax planning and insurance needs. One planner told Prather that both his productivity and his business volume had doubled as a result of using the programs.

XQ is using some of Quadram's former office space as well as members of Quadram's marketing and support staff to produce and promote the two programs. Prather is now at work on modifications to the programs designed to take advantage of the color displays offered by the Quadcolor board and Quadchrome monitor. ▲

channels for enhancements. That gives us a lot of flexibility. And ours is the only public company that's a factor in the peripherals market. We'll be there for warranty service years from now."

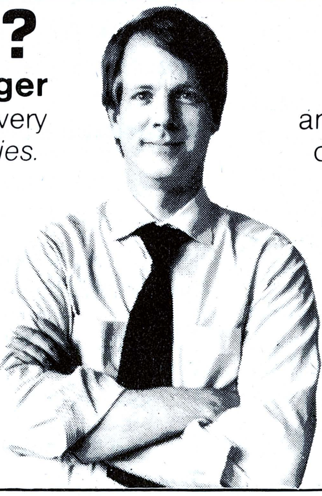
A Touch of Strange. One of the ways Strange attempts to make sure that Quadram will continue to be in the market is by keeping in touch with that market. "I will try to speak to at least one computer dealer a day and find out what the consumer is asking for," he says. "Sometimes I ask to talk to the technician. The technicians have a great understanding of the marketplace."

Even while vacationing in Florida recently, Strange stepped off the beach long enough to wander into a computer store and talk to a salesman about business and products. It's a source of ideas, he says, and it helps build rapport.

That salesman might not have known that he was talking with one of the principals of the company, however. Neither Strange nor Farris, nor any other Quadram executive, has a title on his business card. The cards reflect an aspect of the company's operating philosophy—that everyone is able to pitch in on a job.

Another element of that philosophy is a strong commitment to advertising. In May of this year, Adtrack rated Quadram as the number one consumer advertiser, saying that Quadram spent more money educating the public about its products than did any other firm. Strange reports that 7 to 12 percent of the firm's sales dollars go back into advertising. And future plans call for television spots, something he feels is necessary to reach the growing computer-buying public.

And when that public confronts Quadram, they'll meet up with a group of people for whom quality is a watchword—as well as a tradition. ▲



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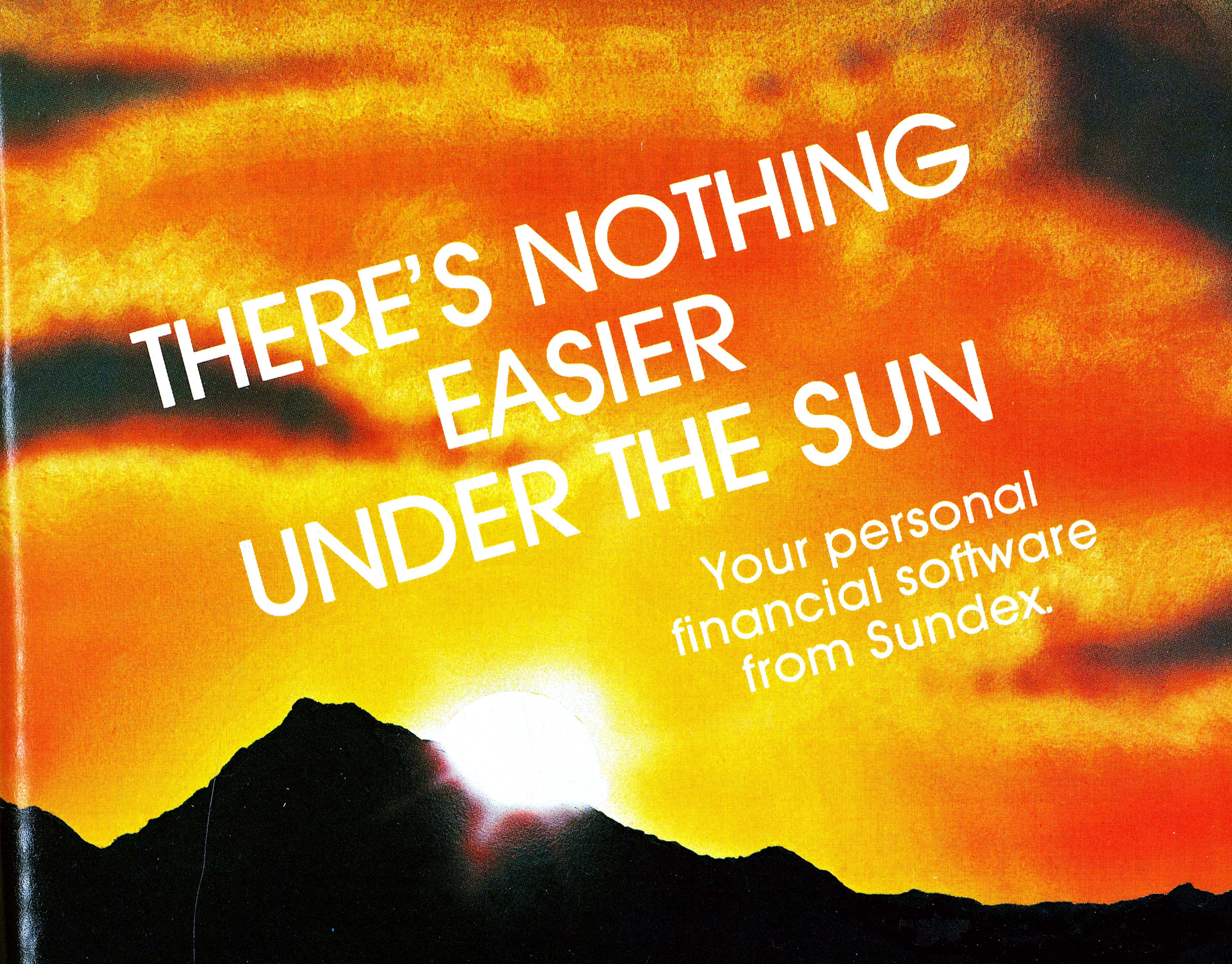

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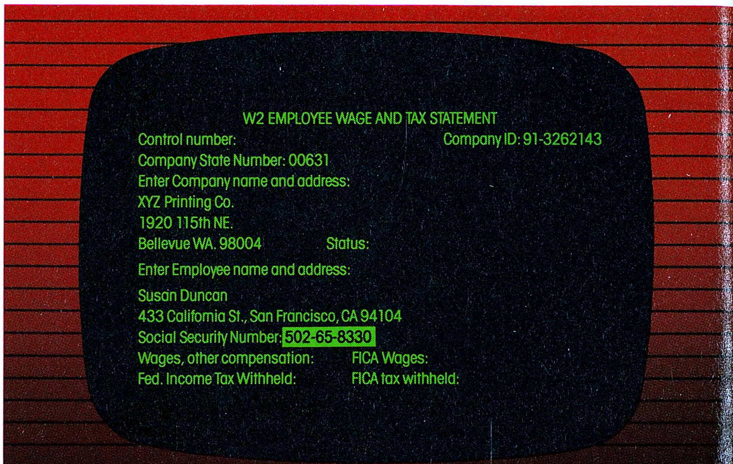

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R:base is also very forgiving. It's very hard to make a mistake. That's because commands are simple English expressions—like SELECT, PROJECT, WITH, WHERE, FROM, etc. Dates and dollar amounts are written normally: 11/16/83;

	MAXIMUM RECORDS/ DATABASE	*FILES AVAILABLE CONCUR-RENTLY*	*MAXIMUM NUMBER FIELDS/ DATABASE*	*TIME TO SORT 1000 RECORDS* (MIN: SEC)*	*UPDATE MULTIPLE FILES CON-CURRENTLY*	*PRICE (LIST)*
R:BASE 4000	100 billion	40	400	0:59	Yes	$495
dBASE II	65,535	2	32	5:47	No	$695
CONDOR	32,768	2	127	2:03	No	$650

*Sort 1000 records on 1 key value. (IBM PC with 256K and DS/DD diskettes)

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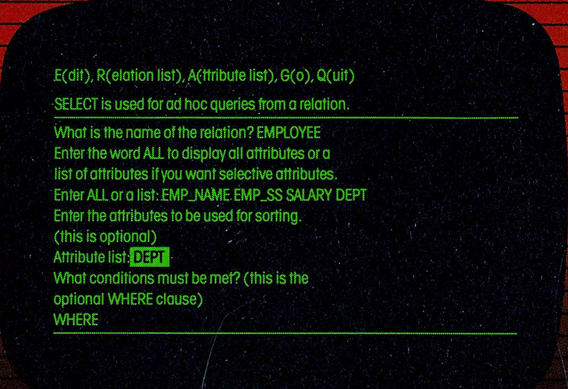
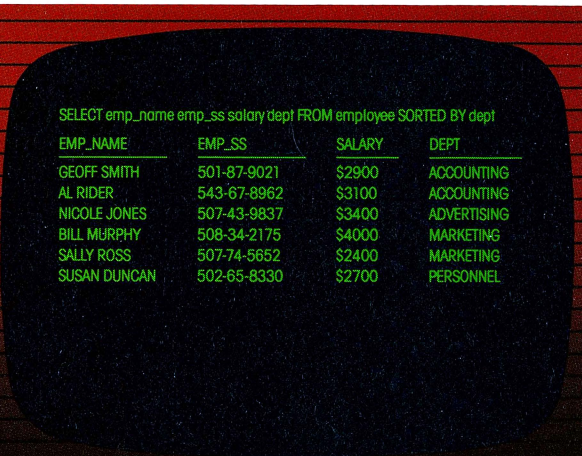


```
E(dit), R(elation list), A(ttribute list), G(o), Q(uit)
SELECT is used for ad hoc queries from a relation.
------------------------------------------------------------
What is the name of the relation? EMPLOYEE
Enter the word ALL to display all attributes or a
list of attributes if you want selective attributes.
Enter ALL or a list: EMP_NAME EMP_SS SALARY DEPT
Enter the attributes to be used for sorting.
(this is optional)
Attribute list: DEPT
What conditions must be met? (this is the
optional WHERE clause)
WHERE
------------------------------------------------------------
```

New users can also choose to have command prompting. All you do is answer a sequence of plain-English questions by filling in reversed-out fields. R:base does the rest.



```
SELECT emp_name emp_ss salary dept FROM employee SORTED BY dept
EMP_NAME        EMP_SS          SALARY      DEPT
-------------   -------------   ---------   -----------
GEOFF SMITH     501-87-9021     $2900       ACCOUNTING
AL RIDER        543-67-8962     $3100       ACCOUNTING
NICOLE JONES    507-43-9837     $3400       ADVERTISING
BILL MURPHY     508-34-2175     $4000       MARKETING
SALLY ROSS      507-74-5652     $2400       MARKETING
SUSAN DUNCAN    502-65-8330     $2700       PERSONNEL
```

And here's your list. Notice that the command formed by "filling in the blanks" on the previous screen is written out to teach new users about R:base.

$500.00. And, because data entry verification rules are defined up front, you just can't put any "garbage in"—even if you try!

What's more, R:base allows you to sort and select data on up to ten different criteria, perform totals, and then display the results—all with a single, powerful command (see screens).

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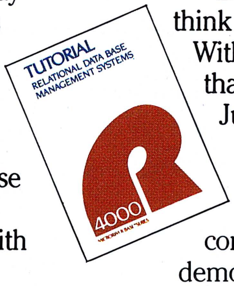

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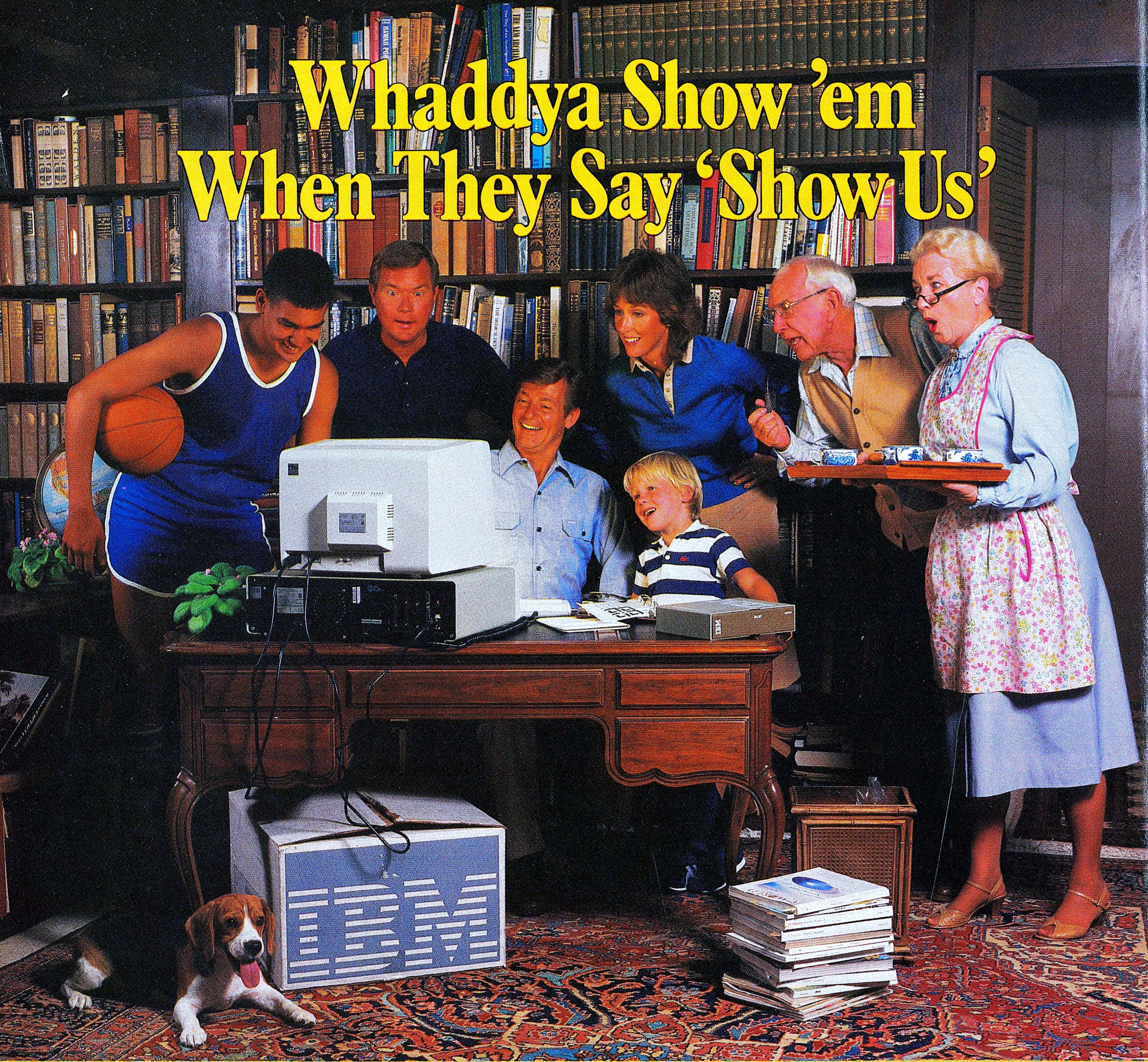

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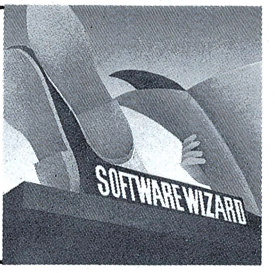

Δ **Bruce Zweig,** founder of **Lightning Software** (Palo Alto, CA), has sold Lightning to **Scarborough Systems** (Tarrytown, NY) for cash and royalties equaling seven figures, according to **Sanford Bain,** vice president of marketing at Scarborough. "This was a personal decision about whether I ever wanted to write something again or not. With Lightning I was just too bogged down," Zweig said. In the future he plans to work on several software ideas and may start a new company. Zweig will also serve as a consultant to Scarborough. **Russ Jones,** formerly general manager of Lightning, has become director of West Coast operations for Scarborough and will oversee Lightning's operations in California. Scarborough is a new publisher of educational and productivity software.

Δ The hard disk accounting series from **Great Plains Software** (Fargo, ND) has received the first Good Housekeeping-style "seal of approval" given to a microcomputer software system by the **National Association of Retail Dealers of America.** According to NARDA, the package performs its functions as advertised. The retailers' group is four thousand strong and represents twelve thousand retail outlets.

Δ The corporate communications director for **Techne Software** (Lafayette, CA), **Dr. Michael Weiskopf,** has taken a one-year leave of absence from the company to take up the post of visiting assistant professor of ancient history at Tulane University. An expert on ancient Persia, Weiskopf will teach courses and do research in his field of specialization. Before joining the software firm, Weiskopf was a doctoral student at the University of California, Berkeley. He will keep in contact with the home office and continue to handle relations with the press.

Δ **ABM Computer Systems** (Laguna Hills, CA), a pc add-on manufacturing company, has filed with the SEC for an initial public offering of one million shares at two dollars per share. Underwriter for the stock offering is **Wilson Davis & Company** (Salt Lake City, UT).

Δ **MicroPro International** (San Rafael, CA) has named **H. Glen Haney** president and chief executive officer and **Seymour Rubinstein** chairman of the board of directors. Haney was formerly vice president, business strategy and new markets for Sperry Computer Systems. He brings more than twenty-five years of mainframe and minicomputer experience to his new position. Rubinstein, founder of MicroPro, was the original president and chief executive officer of the company.

Δ World War I was restaged this past August at the Schellville Airport (Sonoma, CA) by **Synapse Software** (Richmond, CA), in promotion of the company's new air combat arcade game, *Blue Max.* One of the events, which included a vintage biplane air show and free rides, was a simulated bombing raid contest. Synapse president **Ihor Wolosenko** and executive president **Ken Grant** withstood wave after wave of attacks from magazine editors in biplanes. The embattled top brass were positioned in a target zone on a dirt airstrip, protected by bales of hay, champagne, and an unloaded machine gun. An editor of *Video Store* magazine won the contest by scoring a direct hit with a loaded flour bag.

Δ **Softsmith,** the distribution arm of **The Software Guild** (Union City, CA), has announced it will begin a six-month test with the nineteen **Waldenbooks** stores in the San Francisco Bay Area. Softsmith will provide initial training to the managers of the nineteen stores, since none of the area outlets has previously carried software. A sales kiosk and opening inventory are part of the deal. "We've always felt that bookstores, both independents and those of major national chains, are natural outlets for the sale of personal computer software," said **Rob Lundgren,** vice president and general manager of Softsmith. "Waldenbooks will give us an excellent chance to prove it." If all goes well, the test program will extend to the "rest of the eight hundred Waldenbooks outlets nationwide."

Δ **Dale Rose** has been appointed national sales manager at **Sirius Software** (Sacramento, CA). Rose assumes responsibility for the management of the company's national distribution network and sales-related activities. He previously spent twelve years in sales and sales management at American Standard.

Δ A video-based tutorial publisher, **Micro-Video Learning Systems** (New York, NY), has announced its move to new headquarters: 119 West Twenty-second Street, New York, NY 10011. The Manhattan digs house the company's full-service video production facility under one roof.

Δ **Educational Computer** magazine (Cupertino, CA) has announced the appointment of **Lynne Stickrod** as director of marketing. Stickrod will be responsible for developing marketing strategy and will be involved in ad design, new programs, ad rep support, and sales. Having taught high school English and history for four years, she has a strong educational background as well as sales and marketing experience.

Δ National and international news from

United Press International (UPI) is now available on **NewsNet** (Bryn Mawr, PA). Business, sports, politics, and news can be monitored and downloaded using the NewsFlash system, a set of keywords denoting areas of interest. When a chosen subject comes on the wire, a match is reported in headline form at sign-on time. Δ NewsNet has also announced the availability of News-a-tron's twice-daily *Petro Futures* newsletter. Each day's report provides cash prices for crude oil, gasoline, propane, and Number 2 heating oil. Analysis of interaction between cash and future markets is included.

Δ **IBM** (Delray Beach, FL) has announced a new authorization program that permits qualified retail software stores to sell IBM's pc software. Previously, only authorized IBM Personal Computer retail dealers, IBM Product Centers, and IBM market reps could sell the software. **Softwaire Centres International** (Los Angeles, CA) is one of the first outside dealerships to qualify under the new program. Several Softwaire Centre locations are now authorized IBM Personal Computer software dealers. Δ **American Training International** (Manhattan Beach, CA) has signed with IBM to market the company's interactive computer training software through IBM Product Centers, IBM's National Accounts Division, and its National Marketing Division.

Δ Some distributor action at **Lotus Development Corporation** (Cambridge, MA): **Compuserve** (Vancouver, B.C.) has been signed as sole distributor to retail outlets in Canada, including ComputerLand. The distributor is one of the largest in Canada, selling to more than four hundred dealers. Δ **Micro D** (Fountain Valley, CA) and **Softeam** (Culver City, CA) have been added to the company's U.S. distribution network. Softeam distributes to more than twenty-five hundred independent computer software dealers.

Δ Four sales regions covering the United States and Canada have been established by **Enter Computing** (San Diego, CA), in a move to decentralize the company's tech training and support. Reporting directly to company president **David Purcell** are four newly appointed regional sales managers: **Robert Sherwood,** West; **John Merris,** Midwest; **Sanford Dean,** Southeast; and **Robert Curtis,** New England. The four regions also support those Canadian provinces that border them.

Δ **Softeam** (Culver City, CA) has signed with **Business Software Pty. Ltd.** (Chastwood N.S.W., Australia) to manufacture and distribute the latter's financial software in America. The two packages, *Planfin* and *Profin,* will be featured products in this month's Future Star dealer program.

Δ **Daniel B. Rosenthal** has joined **Techland Systems** (New York, NY) as vice president of finance. Rosenthal was former director of corporate finance planning at Sperry & Hutchinson. His first duty is to implement a complete financial control system on the company's in-house network of pcs.

Δ **VisiCorp** (San Jose, CA) has acquired worldwide rights to the *StretchCalc* program and technology from **Multisoft** (Beaverton, OR). The program had previously been marketed independently as an enhancement to *VisiCalc.* "This enables VisiCorp to further strengthen its leadership position in electronic spreadsheet software. The combined capabilities of the two programs result in a level of price and performance that is clearly superior," according to **Bruce Shafer,** Multisoft president.

Δ Two packages from **Continental Software** (Los Angeles, CA) will be marketed in modified form for junior high school, high school, university, and adult education classes by **South-Western Publishing** (Cincinnati, OH). Both companies consider the educational market an important area of growth; it's Continental's first venture into the realm. *Home Accountant* and *Tax Advantage* disks modified to include teacher instruction, student workbook manuals, and a teacher's manual will be part of the educational repackaging.

Δ The *TK!Solver* package from **Software Arts** (Wellesley, MA) has gone international, having been shipped to distributors in the U.K., New Zealand, Australia, Sweden, and Canada. These distributors in turn will shoot the problem-solving software off to dealers in Ireland, West Germany, Holland, Italy, France, Norway, Finland, and Denmark. Sections of documentation will be translated as necessary. Marketing support reps will be traveling the Continent conducting demos and sales training programs.

Δ **Integral Data Systems** (Boston, MA), a leading manufacturer of microcomputer printers, reached a corporate milestone as it delivered its one hundred thousandth printer. The color printer was presented to **ComputerLand of Boston,** which in turn donated it to Boston's **Cotting School for Handicapped Children.** The school will use it in its computer sciences program for elementary and secondary students. It is their first color printer.

Δ **Source Telecomputing** (McLean, VA) has contracted with **Uninet**, a major telecommunications network, to provide long-distance services for members of the company's videotext service, the Source. Local access in thirty-six cities previously not served by other networks will help accommodate the two thousand new members joining the Source each month. New cities now serviced include Babylon, NY; Cape Canaveral, FL; Sheboygan, WI; and Pomona, CA. ▲

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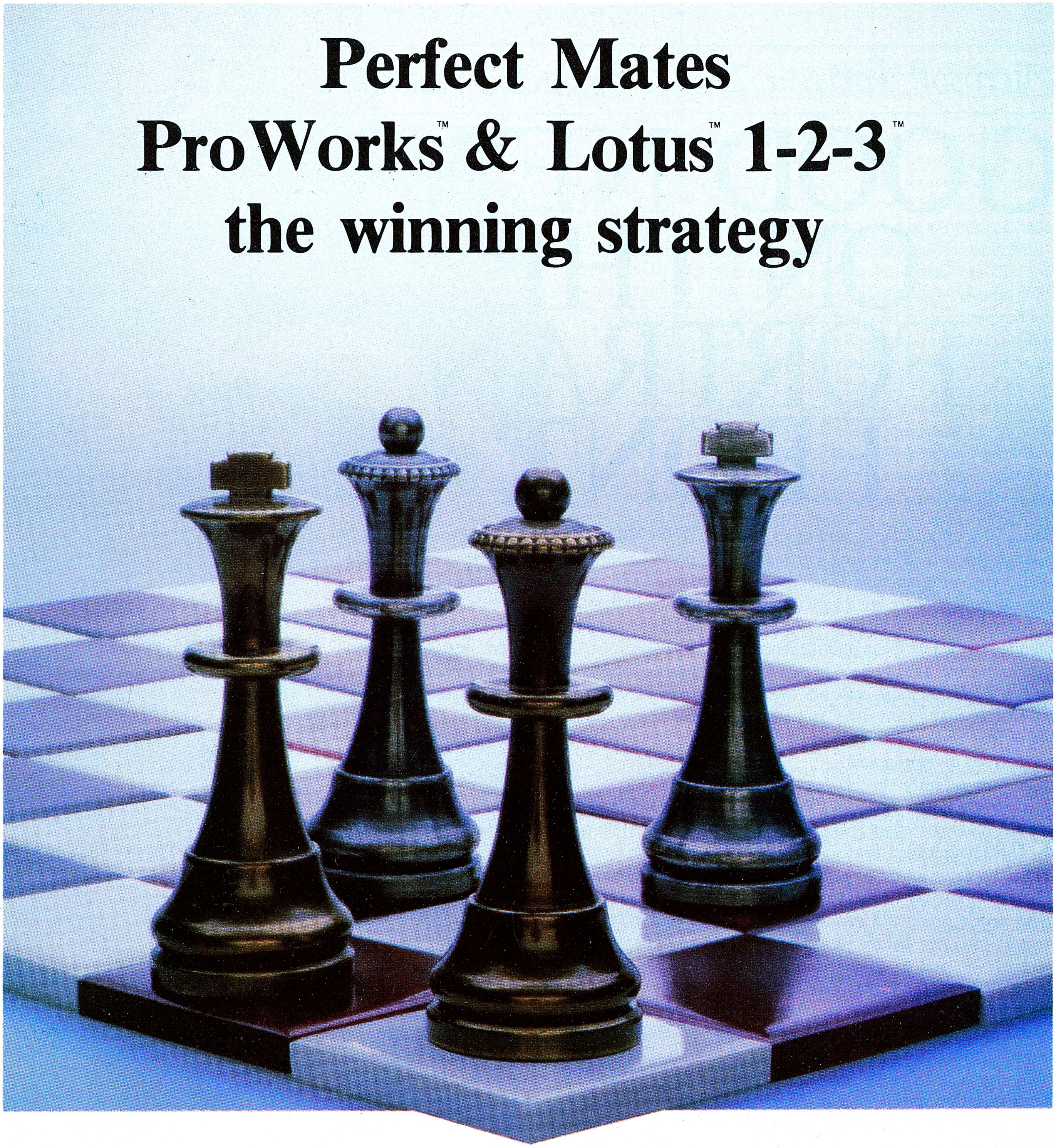

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Microsoft Fortran 77 *by Jack Wilschke*

GOOD NEWS ON THE FORTRAN FRONT

Pascal, Modula, Ada, C, and other "modern" languages notwithstanding, Fortran is still a vital, living programming language with a strong following. There are a good many reasons for its continuing vitality, including but not limited to the fact that a quarter century of programming has already been invested in the language. Probably more code has been written in Fortran than in any other language, and much of that code is available for incorporation into your own programs.

But until recently the programmer who wanted to use Fortran on the IBM Personal Computer had a variety of frustrations to deal with. There hadn't been a satisfactory Fortran compiler available for the pc—until the release of Microsoft's Fortran 77 Version 3.1 last May.

This article presents a review of the new Microsoft compiler. Before we get to the details, however, and to comparisons between this compiler and the earlier versions of Fortran for the pc, we need to review the history of Fortran and establish some criteria for evaluating a Fortran compiler.

IBM developed Fortran in the mid-fifties and released the first version in April 1957. Fortran I was followed in 1958 by Fortran II and, in the early sixties, by Fortran IV (Fortran III got lost inside IBM).

Fortran was the first language standardized by the American Standards Association (later called the American National Standards Institute, ANSI) Committee X3.4. The standard that was produced, ANS X3.9-1966 (Fortran 66), roughly matched IBM's Fortran IV. In the seventies, an enhanced standard, ANSI X3.1978 (Fortran 77), was produced by the ANSI X3J3 Technical Committee. Fortran 77 provides enhanced I/O and structure capabilities as well as a character data type similar to strings in Basic. IBM supports this standard on its large computers as VS Fortran.

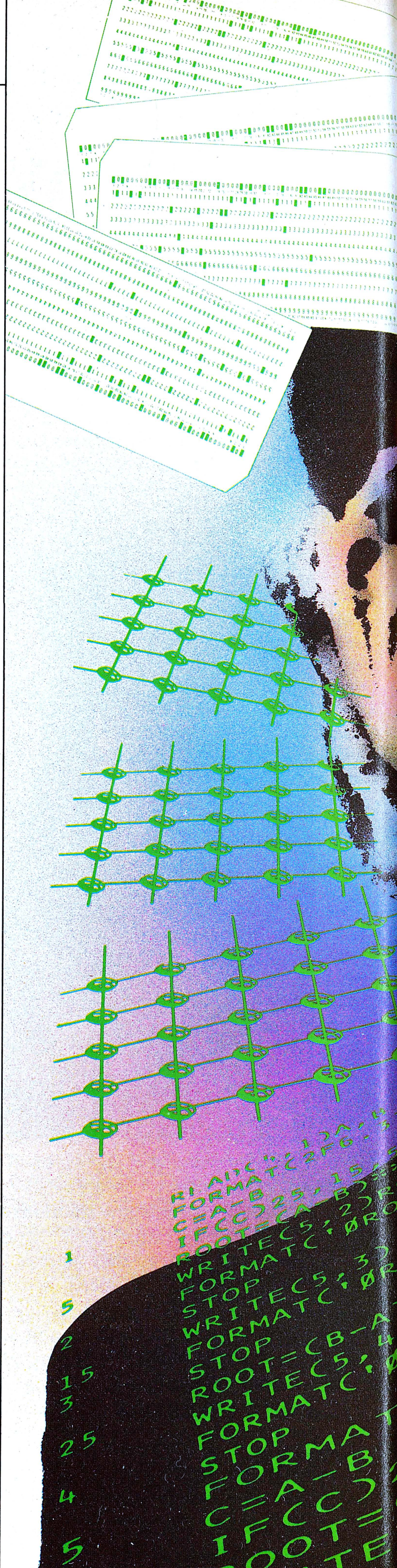
Fortran is currently used in industry, engineering, and academia. Almost all computers, from minis on up, have at least one version of Fortran available.

What Makes a Good Fortran Compiler?

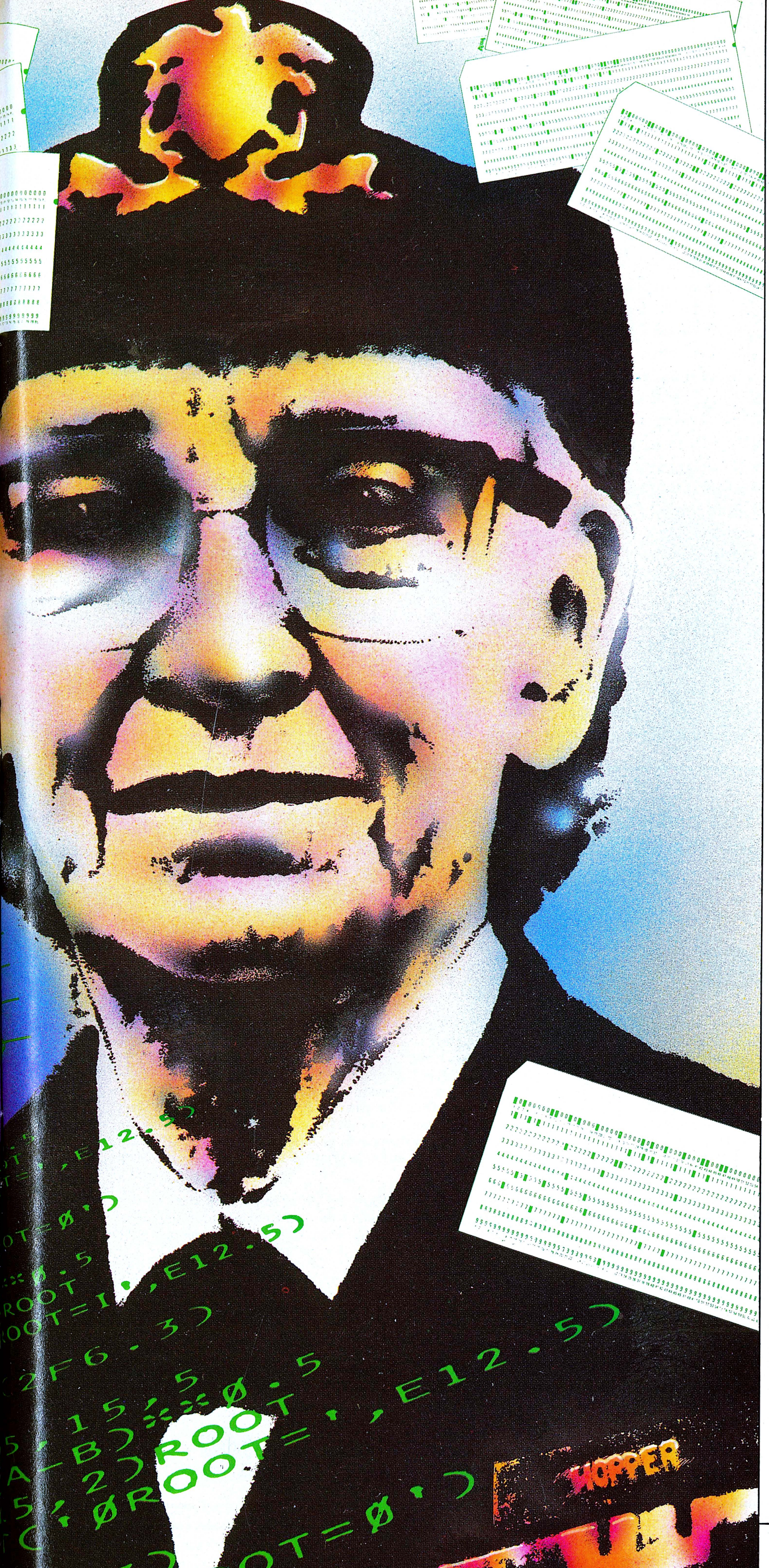
Standardization. The language accepted by the compiler should be as close as possible to a standard Fortran. It should match either the 66 or the 77 standard (preferably the 77). There is a huge amount of code out there that you can avoid redeveloping if you have a standard compiler. And wouldn't it be nice if that program you sweated blood over on your pc would also compile on a PDP/11 or an IBM 3081?

High Precision. Your Fortran compiler should allow you to use double-precision numbers—numbers accurate to fourteen or fifteen decimal places instead of the six or seven provided by single-precision numbers. Even a small business may have to add beyond 99999.99, and no one wants pennies to start disappearing as numbers are rounded off. Also, remember that when you subtract one number from a nearly equal second number using single-precision variables, you may lose a lot of significant figures; 12345.6 minus 12340.0, for example, leaves you with 5.6, a number of only two-place precision.

Fast, Efficient Machine Code. The larger



Although the first version of Fortran was released by IBM in 1957, the work of Grace Murray Hopper in the early '50s led to its creation. Hopper developed the first compiler, A-0, in 1952 and the first compiler to handle symbolic manipulation, A-2, in 1953. Based on her work with these compilers, Hopper completed the first English language data processing compiler, B-0 (Flowmatic), in 1957, which proved to be the foundation on which Fortran was developed.



your program, the faster you will need the machine to work. Since the pc is not the fastest computer in the world, your compiler should help by providing the most efficient possible machine code. And since a number-crunching program spends most of its time adding, subtracting, and so on, the compiler should be able to use the 8087 numeric coprocessor powerhouse that IBM has finally announced (we all knew that socket would be used some day).

Control over the Environment. The compiler and/or operating system should allow you to have control over your microcomputer environment. Provisions should be available to handle input from the keyboard and output to the screen and printers. Control of the cursor should be available, and graphics capability is becoming more important all the time. You should be able to link your programs to other routines written in assembly language or maybe even other languages. Disk files should provide the ability to pass data on to other programs not necessarily written in Fortran.

Large Program and Data Area Size. Fortran was designed to do large amounts of numerical calculations. These calculations could give an answer to an algebraic problem or a position on a display, or even the scores and averages of your bowling team. In any case, large amounts of memory could be required for both the program and the data you want to crunch. A Fortran program should allow you to use that 256K or more that you paid good money to put in your pc.

Good Documentation. A compiler cannot be used to its fullest extent if the programmer doesn't know what it can and can't do. The documentation must explain any nonstandard parts of the implementation as well as any of the compiler's limitations. Examples of the compiler's use are essential, as is a full description of all errors and their probable causes.

Earlier Fortrans for the pc

For comparison, let's review some of the other Fortran compilers available for the pc.

IBM Fortran Version 1.0. As the original creator of Fortran, Big Blue should be turning red with embarrassment. Their first Fortran compiler for the pc should never have been allowed on the market. At last count there were forty-five (yes, 45) pages of known errors with patches or ways to work around the problems. Those of you who were unfortunate enough to have purchased Fortran 1.0 can get an already patched update, but you have to know to ask your dealer for it.

Here are some of the remaining problems.

No double precision. Although IBM's Basic has it, it's not provided in Fortran, a language that deals in high precision.

Real number format incompatible with the 8087. Even if the compiler had the capability to use the 8087 (which it doesn't), the compiler doesn't use the IEEE standard format to store its real (floating-point) numbers. Since the 8087 requires the IEEE format, access to the 8087 by this compiler would be impeded by numeric format conversions. MicroWare (Box 79, Kingston, MA 02364) does offer routines that would allow use of the 8087, but even they admit that the usefulness of these routines is limited by the compiled code's structure. As a historical note, Fortran I was developed to take advantage of one of the first computers to have floating-point hardware, the IBM 704.

Poor communication between keyboard and program. IBM provides a patch to allow you to input data without filling in the exact number of digits expected. However, your cursor still has to be exactly at the right place on the screen.

Poor documentation of defaults. Many users were unaware that the compiler was generating up to two-thirds more code than was necessary. Unless a *$NoDebug* metacommand is used, special debugging code is inserted with every statement, as a means of tracking errors. Four-byte integers are provided by default, even though two-byte integers are usually sufficient and can be processed many times faster. Much of the frustration experienced by early users of this compiler must have been due to these overlooked penalties (see table 1).

Inefficient code. Even with all the correct options set, the compiler still produces inefficient code. IBM Fortran programs can run more than three times slower than the equivalent compiled Basic programs (see table 2).

SuperSoft Fortran IV Extended (Version 1.04). A much more interesting contender as a pc Fortran compiler is the product by SuperSoft. It could be the most efficient Fortran compiler available for the IBM pc. The compiler does offer double precision as well as complex numbers (complex numbers are very powerful tools for solving problems in such areas as electrical engineering). It also has the IEEE real-number format and supports the 8087 coprocessor. This gives it the potential for producing the fastest-running programs of any Fortran compiler. In addition, the libraries supplied contain a variety of subroutine utilities that allow direct access to the system and memory as well as cursor and screen-attribute control.

However, there are flaws that need correction before the SuperSoft compiler can really be considered for many applications.

The compiler limits data space to 64K. This includes all common data (data shared between subroutines), local variables (those used only inside a subroutine), format definition statements (for input and output), the stack (for transfer of data between subroutines), and the heap (file control blocks). With even moderately sized programs, the 64K limitation could be frustrating.

Perhaps this compiler's most serious problem is that it isn't close to being a standard Fortran. Although it calls itself a Fortran IV (66), it has included some, but not all, of the Fortran 77 enhancements. Fortran 77 features, such as Character data, must be manipulated by subroutine calls rather than by the standard operators. The interactive List Directed I/O and error handling are also not 77-standard. In addition, the compiler's lack of a four-byte integer might necessitate extensive reprogramming of older programs.

SuperSoft says it will provide a later version that will overcome several of these problems. It will be very interesting to compare that revised compiler with Microsoft's.

UCSD p-Code Fortran. For two reasons, the Fortran for the UCSD p-System is not in the same class with the other Fortran compilers under consideration here. First, it operates under the UCSD system, which is not the de facto standard for the IBM pc. Second, UCSD Fortran incurs an efficiency penalty by compiling only to the level of p-code.

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Microsoft Fortran 77 Version 3.1

In May, Microsoft released version 3.1 of their Fortran 77 compiler. While not ideal, version 3.1 does provide the essentials in a Fortran compiler. It requires at least 116K of RAM plus space for DOS. Thus if you're using DOS 2.0, you need at least 160K.

MS-Fortran 3.1's language is very similar to that offered by the original IBM Fortran compiler. It even retains many of the same metacommands for control of the compiler options. Thus if you have developed a program for the IBM version, it should compile almost immediately with MS-Fortran 3.1.

The documentation gives a useful description of the limitations imposed on the language by the segmented addressing scheme of the 8088. No main program or subroutine can be larger than 64K. No named common block can be larger than 64K, and the storage space for all the local variables, blank common, format definitions, the stack, and the heap cannot total more than 64K. However, if you break your program up into subroutines of moderate size and use named common blocks, programs and data space can be as large as your available memory.

Access to the 8087. One of the most important features of this compiler is that it uses the IEEE floating-point number format and allows access to the 8087 coprocessor. In fact, Microsoft was so concerned about implementing the 8087 that they gave the programmer a confusing number of ways to get to it.

First, if you do not have an 8087, your program has to call a library subroutine to do such things as add, subtract, or multiply real numbers. The most efficient way is for the compiler to insert into your code a call to the appropriate subroutine. However, it is not most efficient to use a subroutine if you do have an 8087. In order for your program to use the 8087, it has to interrupt the 8088. This is best done with an interrupt command.

Microsoft has given you the option to select at compile time which method you want to use. You can use either method, whether or not you have the 8087. The libraries will compensate if you choose the "wrong" method. However, if you use the wrong method for the configuration of your machine, you can pay a penalty in execution time and program size. The recommended method is to use subroutine calls if you don't have an 8087 (use the metacommand *$NoFloatCalls*) and interrupts if you do (the default).

Your next decision occurs at link time. All compiled programs must be linked to a set of utility subroutines that are contained in a library. These routines handle some very important functions, such as initialization of programs; input/output to the keyboard, screen, printer, and disk drives; and real-number calculations. You have two choices with the Microsoft Fortran libraries. You can link with an 8087 library (Fortran.L87), which requires that you have an 8087 installed. That will give you the smallest program. Or you can link with the emulator library (Fortran.Lem). The latter approach allows you to run your program on any pc. If the pc has an 8087, your program will use it. If it doesn't have an 8087, then your program will carry the extra baggage of unused real-number routines. That may be a small price to pay for the versatility this method allows.

The 8087 speeds up real-number calculations (including real functions such as *sqrt, sin,* and *cos*) tremendously. However, most programs do a lot of other things in addition to

COMPILER COMPARISONS

One of the tests of a compiler is to run a benchmark program on it and on several others. A benchmark program called the Whetstone test was run on the compilers discussed in this article. The program was developed by two British researchers, B.A. Wichmann and H.J. Curnow, based upon Wichmann's statistical analysis of 949 Algol 60 programs. It attempts to do a cross section of integer and real number calculations in a variety of loops and subroutine calls with scalar and array variables. The results presented in the following table show the relative speed of this program as measured in thousands of Whetstone instructions per second. These tests were run as part of a Desktop Computer Study completed in July 1983 by the Douglas Aircraft Company, Long Beach, California.

	.OBJ size Bytes	.EXE size Bytes	Speed 1000 Whetstone Instr/sec
Standard defaults	14681	47744	3.43
With 2-byte integers	12244	45440	3.88
With 2-byte integers and NoDebug on	8797	42880	6.33

Table 1. IBM Fortran Compiler 1.0 Option Comparison

COMPILER/INTERPRETER	.OBJ size Bytes	.EXE size Bytes	Speed 1000 Whetstone Instr/sec
IBM Basic interpreter 2.0	—	—	1.64
Compiled IBM Basic 1.0	5988	22144	21.27
IBM Fortran 1.0	8797	42880	6.33
SuperSoft Fortran IV 1.04 w/o 8087	8832	24832	12.37
Microsoft Fortran 3.1 Subroutine calls w/o 8087	8734	43340	4.30
Microsoft Fortran 3.1 Interrupt Calls with the 8087	8368	33356	72.80

Table 2. Compiler Comparison

numeric calculations. Some time is spent moving numbers from one location to another and doing branching or looping. So even if your program is 95 percent numeric calculation and even if your calculations are performed with infinite speed by the 8087, you'll see only a twentyfold improvement. Benchmark trials typically record speed improvement by factors of 5 to 20. You should expect very small programs that do a lot of calculating to run ten to twenty times faster; for larger programs that do a lot of data moving and other nonnumeric work, a much more modest improvement is likely. Thus the 8087 cannot solve all speed problems, and compiler efficiency is still important.

One benefit of the 8087 is its ability to use double-precision numbers. As previously discussed, accuracy can be lost in calculations if they are imprudently programmed. One way to protect against this loss of accuracy is to use double precision. However, if you were to do double precision without the 8087, you would slow your calculations by at least a factor of four, as well as incur the overhead of moving eight-byte numbers around instead of four-byte numbers. The 8087 does all of its calculations in ten-byte precision. Thus the user of the 8087 incurs only the penalty of moving the larger numbers around in memory. For a benchmark program this amounted to only a 30 percent increase in time (see table 4).

COMPILER	Execution time (minutes)
IBM Fortran 1.0	91 (1-1/2 hours!)
SuperSoft Fortran IV 1.04 w/o 8087	Unable to compile.
Microsoft Fortran 3.1 Subroutine calls w/o 8087	30
Microsoft Fortran 3.1 Interrupt Calls with the 8087	6.2

Table 3. Large Program Comparison (90K code + 100K data)

Microsoft Fortran 3.1 Interrupt Calls with the 8087	Speed 1000 Whetstone Instr/sec
Single precision	72.80
Double precision	55.19

Table 4. Double-precision Comparison

MACHINE/COMPILER	Speed 1000 Whetstone Instr/sec
IBM PC+8087 Microsoft Fortran 3.1 Interrupt Calls	72.8
PDP 11/34 RSX11M F77 Floating Point Hardware MOS memory	181.0
PDP 11/44 RSX11M F77 Floating Point Hardware MOS memory	252.9
VAX 11/780 VMS FORT Floating Point Hardware	668.3

Table 5. IBM pc versus Minis Comparison

Other Features. The file system used by MS-Fortran allows types of files in addition to those provided by Basic. Where Basic requires all sequential files to be formatted (numbers stored as ASCII characters) and random-access files to be unformatted (numbers stored as they are internally in the computer), MS-Fortran allows both formatted and unformatted files to be sequential or random access. In addition, there is a binary type that stores data without any formatting or record structure at all. Sequential files can be opened for both reading and writing at the same time.

The next major feature of the Microsoft Fortran compiler is its ability to interface with the microcomputer environment. The interactive input/output capability is called list-directed I/O and conforms to the Fortran 77 standards. While certain languages, such as Basic, started with a simple I/O scheme where the computer did most of the work, Fortran always used to require the programmer to provide format statements, similar to the print-using commands of Basic. These format statements not only defined how a given output would look on a printer or screen but also required the input to be at given column locations on a punched card or on a screen. Thus a program user could not type in a list of inputs separated by blanks or commas.

All that changed when the 77 standard was introduced, and the ability to free-format both the input and output became part of the language. Microsoft's extensions to this standard also allow the operator to input to the same screen line where a prompt message appears. In addition, MS-Fortran's ability to assign the correct format to the output at execution time provides text-presentation capabilities beyond those expected in a "scientific" language.

The greatest flaw in Fortran, its lack of cursor and screen-attribute control, has been overcome by PC-DOS 2.0. If a Config.sys file containing a *device = ansi.sys* command is available when the system is started, characters sent to the screen are intercepted. They are then interpreted as screen-control commands if they are preceded by an escape code (ASCII 27). This procedure is similar to sending escape codes to the printer for format and option control. By this method, a Fortran program can send codes to clear the screen, position the cursor, and change the text color and type.

It is also possible to change the display from forty to eighty characters and go into graphics mode. It is unclear whether actual graphics can be done without special subroutines, but such subroutines should be available from independent sources in the near future. Thus the power that Basic provides to manipulate the screen is now available in any language that allows the transmission of escape codes.

Disappointments. One of the major shortcomings of MS-Fortran is that it does not include the character-manipulation operators that are called out in the full Fortran 77 language. The ability to concatenate character variables or manipulate substrings has not been provided. You can do these manipulations crudely by using the internal file feature to write data out to memory and then selectively read it back in under a different format. This method is clumsy at best and is no match for the convenience and power of the ANSI 77 operators.

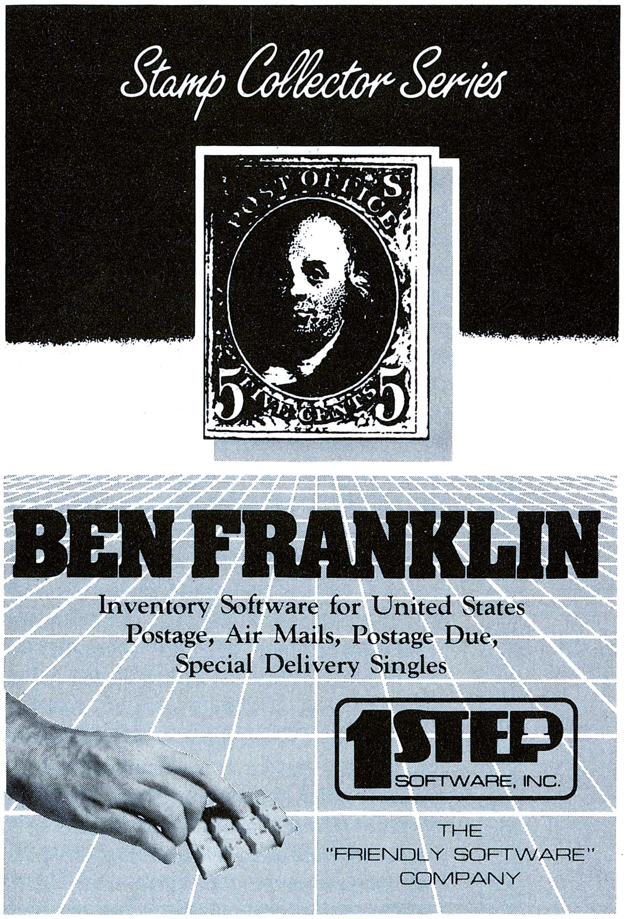
There is a paradox that cannot yet be explained. For a short program the Microsoft compiler produced code that ran as much as 20 to 30 percent slower than the same code produced on the old IBM compiler. However, for a large program that uses 90K of code and 100K of data, the Microsoft compiler produced a program that ran three times faster than the IBM-compiled version. All these comparisons were run without use of the 8087 coprocessor. Since the SuperSoft compiler is still approximately twice as fast as either IBM or Microsoft for the benchmark programs, there still seems to be room for improvement (see tables 2 and 3).

One feature that never seems to get enough attention is error messages. Microsoft has not set any new standards in this respect. The manual lists eight pages of compile-time errors, none of which have more than eight words of explanation! While some explanations are sufficient, most are not. It would be very helpful to the beginning programmer if the documentation gave a fuller description of the error (and maybe even an example). Why do they think we all grew up programming and automatically know what "FORCES LOCATION IN NEGATIVE DIRECTION" means? Any document meant for the microcomputer market has to assume a wide variation in user knowledge and must provide better error documentation. In addition, a flaw that all the microcomputer Fortran compilers seem to share is a failure to check for format statement errors at compile time. They don't even check for the required parentheses until you have your program running.

The MS-Fortran documentation is very helpful in getting you started with the compiler. You are given examples of the use of the compiler and linker, as well as excellent advice on staying within code and data size limitations. A section on linking Fortran programs to assembly language and to MS-Pascal subroutines is provided, along with a description of the file and library structure.

The second section of the documentation is a reference guide to the Fortran language as implemented by this compiler. It is just a reference, and, although good, it does not teach you Fortran. Other texts are referenced for those wanting to know more about the language itself.

Summary. Microsoft has come out with the first Fortran 77 compiler that takes advantage of the full addressing capability of the 8088 and the power of the 8087. It allows the IBM pc to compare quite favorably with minicomputers of much higher cost (see table 5). One can only hope that some further improvements in the basic efficiency of the non-8087 code can be provided. Shortcomings notwithstanding, Microsoft has given the pc owner access to twenty-six years of programming history by providing a workable Fortran. ▲



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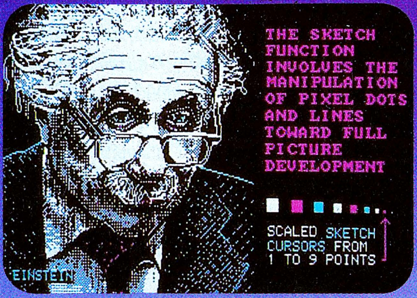

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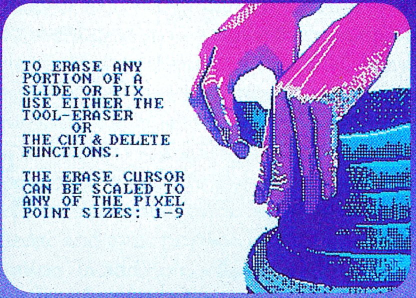

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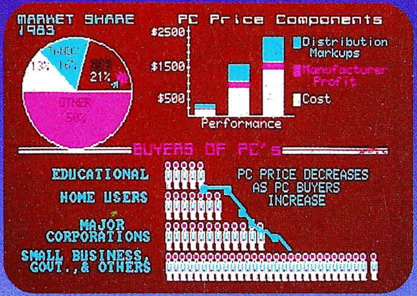

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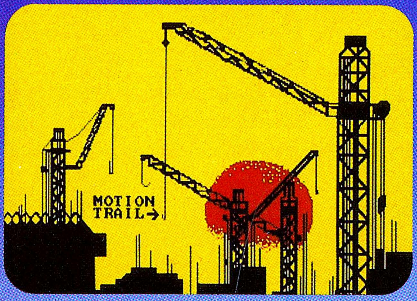

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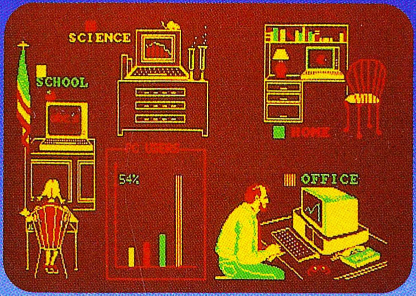

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THE PROFIT PLOT

by Jack Grushcow

Spreadsheets and the Securities Market, Part 2

Last month, Profit Plot discussed the nature of stock portfolios and how you can tailor your investments to suit your own personal needs. You'll remember that there are two types of investments: growth investments, which are more aggressive, and income investments, which are more conservative. This month we will learn how to plumb the depths of a company's soul and explore the fundamentals of analyzing financial statements to rank companies on the growth/income spectrum.

Your careful investigation of financial statements can reveal the inner workings of a company. Hidden within the numbers lie clues to the effectiveness of a company's management, the desirability of its product or service, and its general financial health and future prospects. If you learn enough about the basics of financial statements, you can build and intelligently use a spreadsheet to analyze corporate health.

You can use financial ratios (comparing numbers found in different sections of the statements) to analyze the entire spectrum of a company's operation. There is a wide range of information to choose from, and different people look for different things when they analyze a financial statement. You will save a lot of time and avoid mistakes if you decide what you need to know before you begin looking.

Who Uses Financial Ratios? Most of the people using financial ratios are stock market investors, who have developed ratios to the point of being an art form. Potential investors need answers to such questions as: Can the company afford to pay dividends now and in the future? How large a price must be paid for the earnings of a company? How many times over do the corporate earnings cover the interest payment on long-term debt? How aggressive or conservative is an investment in this company?

Bank managers are creatures of a different sort. They'll usually be interested in a company's ability to generate the necessary profits to repay a loan and whether there are enough assets available to guarantee the loan against default. It's no wonder that many people say that by the time a bank will lend you money you probably don't need it.

If you are a potential trade creditor, your lot will be similar to the bankers'. You'll be concerned mainly with short-term debt and how well a company can handle it.

On the other hand, owners and managers often use financial ratios to assess their own companies' health. These people want answers to such questions as: How well are the corporate assets being used? Where can operating efficiency be improved? Are receivables being collected quickly? Does inventory stay on the shelf too long?

Managers also need to find out if there is a comfortable working capital cushion or if the company has enough cash to consider expansion plans. Managers want to increase operating efficiency and need enough information about the company's financial position to formulate intelligent plans.

Bank managers, trade creditors, owners, and managers as seekers of corporate truth have a lot in common, even though the specific information they each require is different. Each wants to understand the financial position of a company and better gauge its future prospects. Regardless of your vantage—investor, banker, trade creditor, or concerned manager—you will want to learn how to build your own crystal ball with key financial ratios.

Widget Manufacturing Company. The income statement and balance sheet of the hypothetical Widget Manufacturing Company will help you practice using the financial ratios. There is no point building a spreadsheet filled with financial ratios until you know how to construct and interpret each one. (Resemblance of Widget Manufacturing to any company living or dead is purely coincidental.)

WIDGET MANUFACTURING COMPANY
Balance Sheet (in thousands)
December 31, 1982

ASSETS		
1. Cash	20,500	
2. Receivables	46,500	
3. Inventory	37,000	
4. Deferred Taxes (current)	6,000	
5. Total Current Assets		110,000
6. Investments	1,000	
7. Property, Plant, and Equipment	298,000	
8. Accumulated Depreciation	201,000	
9. Net Property, Plant, and Equipment	98,000	
10. Goodwill	5,000	
11. Total Assets		213,000
LIABILITIES		
12. Accounts Payable	38,500	
13. Income Tax	11,000	
14. Long-term Debt (due within one year)	3,500	
15. Total Current Liabilities		53,000
16. Long-term Debt	49,000	
17. Deferred Income Tax	11,000	
18. Total Liabilities		113,000
SHAREHOLDERS' EQUITY		
19. Preferred	12,500	
20. Common	54,000	
21. Retained Income	33,500	
22. Total Shareholders' Equity		100,000
23. Total Liabilities and Shareholders' Equity		213,000

Figure 1.

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BRADY

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The Four Cardinal Points of the Financial Compass. Financial ratios can be classified as liquidity, long-term solvency, efficiency, and profitability ratios. Each category reveals information about a different aspect of a business' operations. Let's take a brief look at each one of these ratios before looking at the liquidity ratios in more detail. We'll be covering the other three next month.

Liquidity measures how much cash a company can raise on short notice and indicates how well the company is positioned to meet its short-term operating requirements. Working capital is probably the best-known measure of liquidity. After all, you have to meet payroll before you do anything else.

Opposite liquidity are the ratios dealing with long-term solvency. These ratios reveal how well a company is balanced to meet the challenge of the future. Capital available for expansion and growth are measured, and the impact of any long-term borrowing strategy is also examined. A company burdened by debt has a serious obstacle on its road to success.

Efficiency ratios form the third group. As the name implies, these ratios measure how well a company manages its resources. Receivables and inventory management can seriously affect corporate profits. Efficiency ratios also measure how well working capital is used.

The final group of ratios are the profitability ratios. These measure profits both in dollar volume and as they relate to the prices of a company's stock. Investors need to learn how to compare these values to stock values of different companies.

Liquidity Ratios

As mentioned earlier, liquidity refers to the amount of cash a company can raise, in relation to its total assets, given relatively short notice. This is a good measure of how secure a company is over a short period of time and also shows whether cash and other short-term assets are being managed efficiently. Keep in mind that these liquidity ratios are focused specifically on the short term.

Working Capital Ratio. A key measure of liquidity is working capital: the difference between current debts and current assets. You examine your working capital at least once a month; it's one way to keep checks from bouncing. You have a certain amount of money coming in and a certain amount going out; the object of the game is to try to pay the bills that need to be paid and still have money left over for fun.

A company goes through the same type of balancing act, except that its idea of fun is making profits for the shareholders. Cash comes in and goes out each month, and the excess of corporate current assets over current liabilities is a company's working capital. When a company runs low, it is usually a sign that it is on the verge of going out of business; inability to meet short-term operating commitments is often the first stage of a corporate collapse.

Current liabilities represent money that a company owes and must pay in the near future. These liabilities are usually short-term bank loans, payroll, accounts owing for raw materials or other supplies that are necessary for the daily operation of the business, and any other debt that must be paid within a year.

Current assets, the other side of the working capital picture, are the assets a company could turn into cash within one year, should the need arise. Securities, accounts receivable, and many types of inventory are typical examples of current assets.

To determine the working capital ratio (or current ratio), you divide the current assets by the current liabilities.

WIDGET MANUFACTURING COMPANY
Income Statement (in thousands)
For year ended December 31, 1982

24.	Net Sales	249,000	
25.	Cost of Goods Sold	215,500	
26.	General and Administrative	18,000	
27.	Depreciation	3,500	
28.	Total Operating Costs		237,000
29.	Operating Income	12,000	
30.	Interest and Debt Expense	(3,500)	
31.	Investment and Other Income	2,500	
32.	Income before Taxes		11,000
33.	Provision for Income Tax	3,100	
34.	Net Income		7,900

Consolidated Statement of Retained Income
For the years ended December 31, 1982

35.	Retained Income (beginning)	31,700
36.	Net Income	7,900
	Dividends	
37.	Preferred	800
38.	Common (2,500,000 outstanding)	5,300
39.	Retained Income	33,500

Figure 2 .

You'll notice that the Widget financial statements (figures 1 and 2) are numbered by item; these item numbers will provide a convenient way to refer to the numbers used in our ratio calculations.

Working Capital = Current Assets/Current Liabilities
= Item 5/Item 15
= 110,000/53,000
= 2:1

The working capital ratio comes out to 2:1 for Widget. Is this result good, bad, or so-so? Generally speaking, a working capital ratio of 2:1

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is good for a manufacturer, but not exceptional. It says simply that Widget has about two dollars of current assets available to cover each dollar of current debt. Based on this ratio, it looks as if there isn't any problem with Widget's working capital reservoir.

If 2:1 is good, is 20:1 ten times better? Definitely not. If a company's working capital ratio exceeds 5:1, it probably has an unnecessary accumulation of cash and other current assets. This indicates several possible problems.

If sales are slow, then a company may be carrying an overly large inventory. Since inventory appears in the financial statements as an asset, the working capital ratio increases.

Poor credit management can cause accounts receivable levels to increase as well. If bills are not being collected, then accounts receivable increase and thereby increase the working capital ratio. An investor should investigate further to discover the cause of an unreasonably high working capital ratio.

In counterpoint, a ratio of less than 2:1 indicates a possible cash bind, which forces creditors to wait a long time for payment. A low ratio warns potential trade creditors and investors that all is not well with the company.

When examining the working capital ratio, keep in mind that not all current assets are created equal. For example, suppose there are two manufacturing companies with similar current ratios. Company J may have a large percentage of its current assets in inventory, while Company K may have the majority of its current assets in cash and accounts receivable. Company J is not as liquid as Company K, because inventories are sometimes very hard to turn into cash and are difficult to value, especially in times of high inflation. As a result, inventory values can be overstated, giving a false impression of the company's liquidity. The quick-asset ratio will help us deal with the problem of inventory evaluation, but first, here are a few important points to remember about interpreting ratios.

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Key Points. Many of us have developed a belief in the reliability of numbers. We pay bills, read reports, and draw conclusions based on the mountains of figures we are force-fed each day. In many cases these infallible-looking numbers are anything but infallible. They represent trends, approximations, or just plain educated guesswork. When we say that 2:1 is a good working capital ratio for Widget Manufacturing, the ratio 2:1 is meant as a rough guideline and should be taken as such.

When it comes to interpreting financial ratios, it should be understood that these numbers are representative of the general condition of corporate operations. This is especially true when you consider that a corporation balance sheet is a reflection of just one day out of the company's operating year. As a result, ratios are best used when they're examined over several years, not just one. The spreadsheet model that we'll develop in next month's column will allow us to make more meaningful use of ratios by examining trends over several years.

When comparing one company's financial ratios to another's, you should compare companies that are within the same industry group. A ratio considered acceptable for one industry could be a sign of impending doom in another. You will see some examples of this when you look at the next ratio.

The Quick-Asset Ratio. The working capital ratio can be misleading because the value of inventories, often the largest of all the current assets, can be difficult to ascertain accurately. The quick-asset ratio, also fondly referred to as the "acid test," analyzes the ability of a company to service its short-term debt without figuring in the value of its inventories.

You can determine Widget's quick-asset ratio by subtracting the inventory from the current assets and dividing the result by the current liabilities:

Quick-Asset Ratio = (Current Assets − Inventory)/Current Liabilities
= (Item 5 − Item 3)/Item 15
= (110,000 − 37,000)/53,000
= 73,000/53,000
= 1.4

This gives a ratio of approximately 1.4:1. The quick-asset ratio is a more conservative test of a company's ability to meet its current obligations. As a result, you would not expect to find a ratio around 2:1, as you would with the working capital ratio.

Generally speaking, a quick-asset ratio of 1:1 or better is indicative of a good liquid financial position. However, companies with a quick-asset ratio of less than 1:1 may be just as liquid if they have a high inventory turnover rate.

For example, meatpackers can turn their inventory over once every seven days. A quick-asset ratio of 0.6:1 would be expected in this business because we know the inventory can be readily turned into cash. A manufacturer producing a relatively small number of high-cost products would generate a larger quick-asset ratio, because it is much more difficult for such a manufacturer to turn inventory to cash.

This illustrates nicely the point discussed earlier about the problems of comparing different industries to each other. To make valid conclusions based on the ratios you calculate, you need to compare them to the appropriate industry average. Dun and Bradstreet and Robert Morris and Associates publish complete lists of financial ratios by industry type. By comparing ratios from the companies that interest you with the industry averages, you can know whether a ratio is acceptable or not.

Widget Manufacturing's quick-asset ratio of 1.4:1 is within generally acceptable limits. Based on both liquidity tests, Widget seems to be in good shape; you might do well to invest in Widget.

Next month we'll continue by discussing the other three major groups of financial ratios. We will then design and build a spreadsheet that uses all these ratios to perform detailed corporate analysis. ▲

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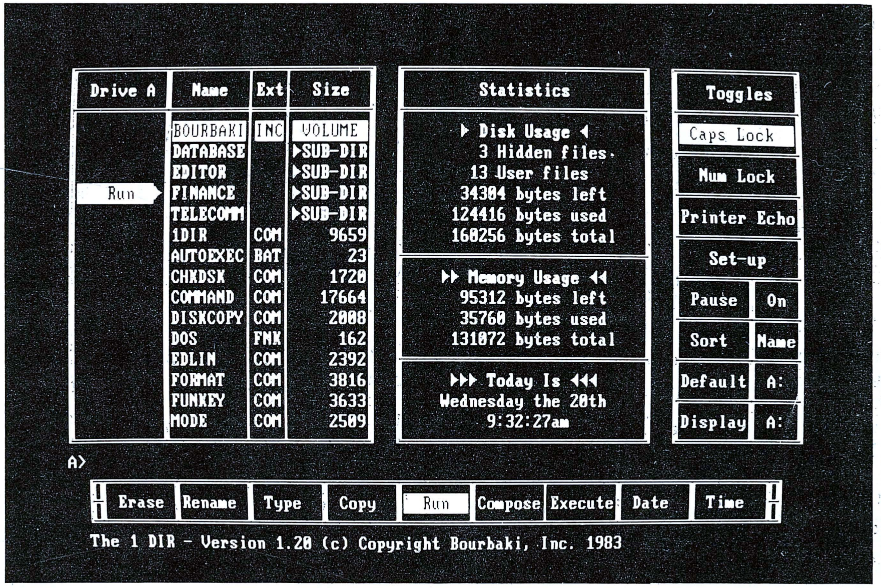
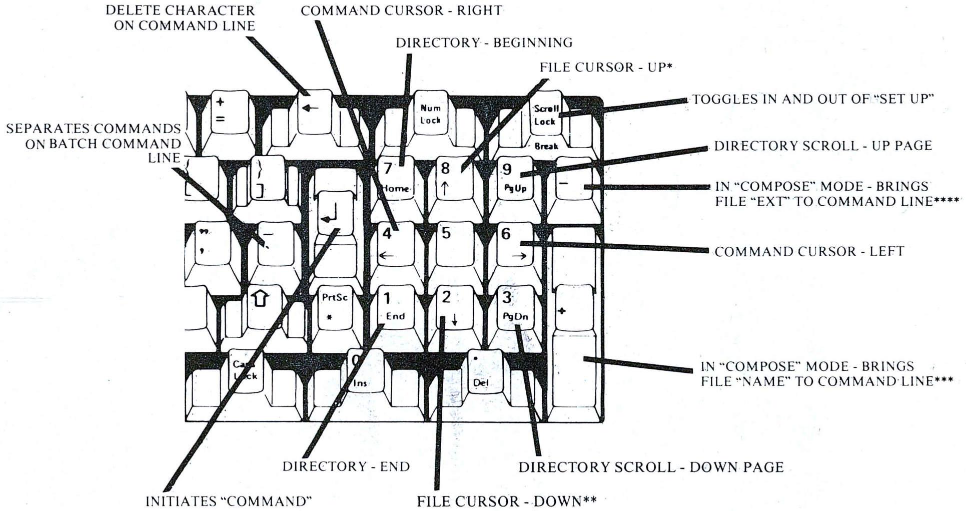


```
Drive A | Name     Ext  Size     |      Statistics       | Toggles
        | BOURBAKI INC  VOLUME   |   ▶ Disk Usage ◀      | Caps Lock
        | DATABASE      ▶SUB-DIR |    3 Hidden files.    | Num Lock
        | EDITOR        ▶SUB-DIR |   13 User files       | Printer Echo
  Run   | FINANCE       ▶SUB-DIR |  34304 bytes left    | Set-up
        | TELECOMM      ▶SUB-DIR | 124416 bytes used    | Pause   On
        | 1DIR     COM     9659  | 160256 bytes total   | Sort    Name
        | AUTOEXEC BAT       23  |                      | Default A:
        | CHKDSK   COM     1720  |  ▶▶ Memory Usage ◀◀   | Display A:
        | COMMAND  COM    17664  |  95312 bytes left    |
        | DISKCOPY COM     2008  |  35760 bytes used    |
        | DOS      FNK      162  | 131072 bytes total   |
        | EDLIN    COM     2392  |                      |
        | FORMAT   COM     3816  |  ▶▶▶ Today Is ◀◀◀     |
        | FUNKEY   COM     3633  | Wednesday the 20th   |
        | MODE     COM     2509  |      9:32:27am       |
A>
 Erase  Rename  Type  Copy  Run  Compose  Execute  Date  Time
The 1 DIR - Version 1.20 (c) Copyright Bourbaki, Inc. 1983
```

(ACTUAL PHOTO)

THE 1dir KEYBOARD


DELETE CHARACTER ON COMMAND LINE
COMMAND CURSOR - RIGHT
DIRECTORY - BEGINNING
FILE CURSOR - UP*
TOGGLES IN AND OUT OF "SET UP"
SEPARATES COMMANDS ON BATCH COMMAND LINE
DIRECTORY SCROLL - UP PAGE
IN "COMPOSE" MODE - BRINGS FILE "EXT" TO COMMAND LINE****
COMMAND CURSOR - LEFT
IN "COMPOSE" MODE - BRINGS FILE "NAME" TO COMMAND LINE***
DIRECTORY - END
DIRECTORY SCROLL - DOWN PAGE
INITIATES "COMMAND"
FILE CURSOR - DOWN**
Num Lock
Scroll Lock
Break
7 Home
8 ↑
9 PgUp
4 ←
5
6 →
1 End
2 ↓
3 PgDn
PrtSc *
Ins
Del
Caps Lock

*IN "SET UP" - CURSOR UP
**IN "SET UP" - CURSOR DOWN
***IN "SET UP" - TOGGLES "PAUSE" ON OR "SORT"TO FILE "NAME"
****IN "SET UP" - TOGGLES "PAUSE" OFF OR "SORT"TO FILE "EXT"

NOTES:
1) TO EXIT TO DOS - ENTER "CONTROL C" (^C)
2) ESCAPE KEY (ESC) IS USED TO DELETE THE COMMAND LINE

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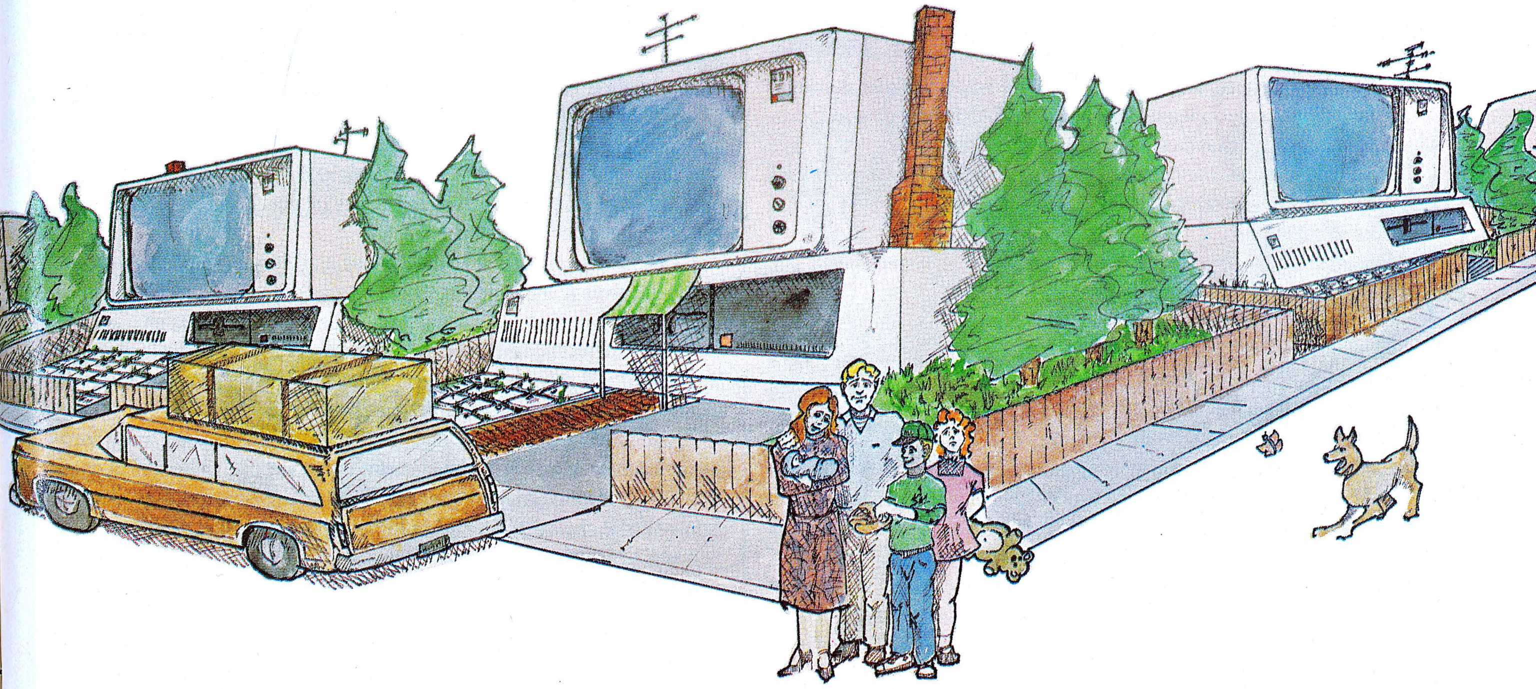
One Man's Journey from pc to XT

MOVING ~~DAY~~ ~~WEEK~~ MONTH

by John Dickinson



Illustrations by Malcolm Rodgers

This saga started out innocently enough. We were driving back from a pleasant day trip to Long Island's Montauk Point, when I said to my wife, "I just want to stop into ComputerLand for a minute."

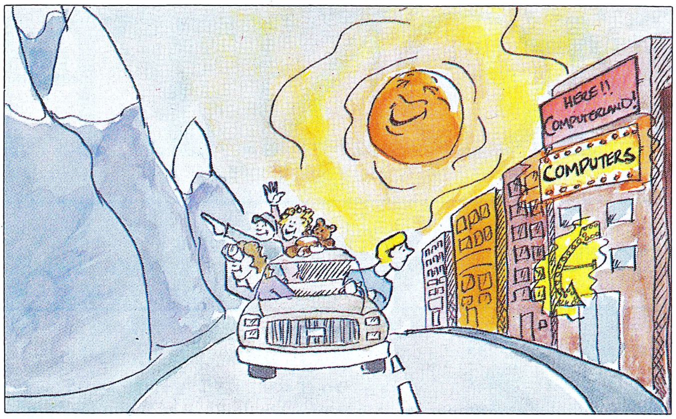
She got a distant look in her eyes as she replied, "Sure, hon.' "

I wanted to look into getting more RAM for my pc. I was starting to develop a database system for my business, and my work so far had indicated a need for a RAM disk large enough to improve the system's performance. Improving the performance alone required more memory than I had. Using the larger disk format of DOS 2.0 (360K versus the 320K of DOS 1.1) would help the application, but 2.0 uses more memory than 1.1, and fitting it on the machine with the application and a RAM disk would present a space problem.

Other applications would benefit from the additional memory and improved operating system as well. The 320K I had between the pc's system board and a QuadBoard was just not enough.

I was greeted by my eternally effervescent ComputerLand store manager. "Hi, John! Nice day for a drive, or looking for something special?"

"Both, actually." I explained my problem. He gave me a skeptical look and said, "Well, you can buy a plain 256K expansion board for a few hundred dollars, but I think you'll be wasting your money."



What? How can you waste money—on RAM for a pc—at ComputerLand? "How's that?" I ventured cautiously.

"Well, the extra memory will help you out for now, but you'll be back looking for something more real soon."

"Like what?"

"Oh, more memory, for one thing—or a Winchester disk."

I listened silently, waiting for his next words.

"Why don't you just bite the bullet and buy an XT?"

"Gimme a break!" I said. "I just got the pc five months ago—why should I buy an XT so soon? It's a nice machine, but I just don't think I need it."

"Yes, you do. Not right this minute, but you will soon. You'll want a hard disk at least, and your alternative to the XT will have to be the IBM expansion cabinet or a non-IBM hard disk. Either one will cost you as much as an XT." We continued talking, and I had to admit that he made a few good points.

For one, the large (256K) memory capacity of the XT's system board, along with the QuadBoard I already had, would give me as much memory (512K) as I could readily use. With the XT's ten-megabyte high-speed Winchester, I might not even need the RAM disk space I had been looking for.

For another, I was not enamored of the alternatives to getting an XT. A friend had just bought an IBM expansion cabinet, and installing it had been a difficult affair.

In addition, the idea of a non-IBM Winchester disk was not attractive to me. While I had long since been weaned of my early Blue-Is-the-Only-Color attitude (witness my QuadBoard and my Amdek monitor), I was convinced that if I ever got a Winchester disk it had to be IBM's so that I could boot the system without inserting a floppy disk. If you're going to spend that much money for a disk, you ought to be able to boot the system from it.

If I Could Sell My pc. . . . We talked about prices. It turned out that if I could sell my pc at a reasonable price, the XT was about the best deal I could find. At worst it was a little more expensive than the alternatives. "I'll have to think about it," I said as I left the store.

"How much was it this time?" asked my wife when I got back to the car.

"Nothing, absolutely nothing," I replied, but I thought about the XT a lot as we drove home.

Quite a bit of time passed—at least eighteen hours—before I drove back to ComputerLand. "Well, I've thought about it a lot," I said, "and I'd like to order an XT."

The manager smiled.

"How long will it take?" I asked.

He stopped smiling. "Oh—about six to eight weeks," he said, somewhat sheepishly.

"No problem." For once I wasn't in a hurry. I didn't have the cash on hand, and getting it would require selling the pc. Since ComputerLand doesn't accept trade-ins, this could take a while.

We settled one more detail. IBM hadn't yet seen fit to produce half-height floppy disk drives to give the XT two internal floppy drives (and the pc four), but I thought they were essential for the XT. Having half-heights would give me the extra drive the machine needed and a downward-compatible two-disk DOS 1.1 system to fall back on in case of DOS 2.0 problems. I also didn't quite trust DOS 2.0's technique of physically formatting nine sectors when making an eight-sector (DOS 1.1) disk, and I needed eight-sector disks for distributing my software products. ComputerLand had the Shugart half-heights on display, so I ordered a pair for my XT.

Astonishingly, for the next couple of weeks I didn't even think about the XT. I was back at my New York office when ComputerLand called to me, "You can pick up your XT tomorrow if you want."

"Excuse me?" I coughed.

"It's here. You can even have it tonight if you're really in a hurry."

"But I haven't even started to sell the pc yet. You told me delivery would take six to eight weeks!"

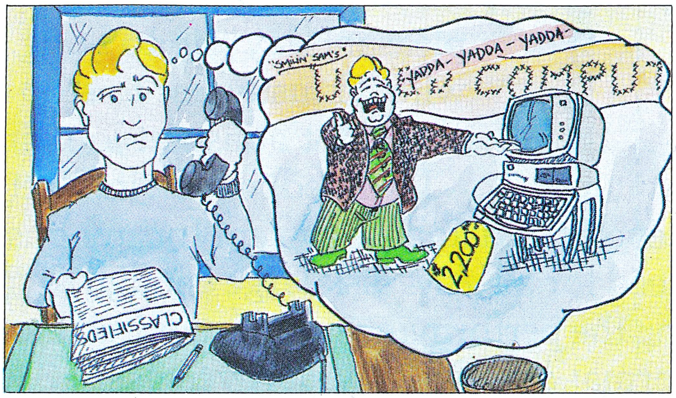
"I can't help it if IBM just dumped a zillion of the things on us. Look, do you want it now or not?" he asked.

"I hope you find a pleasant home for it. I really haven't got the money, and won't until the pc is sold," I said. "I can place an ad today and it'll start tomorrow, but no guarantees as to when I can sell the pc and pick up the new machine."

I called the paper. Keeping the ad out of the "Video and Computer Games" section of the classifieds turned out to be a real communication problem, but the nice lady at the other end of the line finally got it straight. The ad was running in the next morning's paper and on cable TV—a snazzy new service.

Selling used cars had always been painful. This was worse.

IBM's Dirty Deed. One problem was that IBM had increased the system-board memory capacity of the pc (from 64K to 256K) and dropped its price at the time they announced the XT. This was something of a dirty deed for original-model (now called "old-technology") pc owners



(like me) who wanted to sell their machines.

"Oh, you've got the old model," said some callers. "I don't want to buy any junk like that." One fellow was sympathetic. "I just had to sell a TI-99/4A—lost my shirt on it, too," he said.

I was asking $2,200 for the pc (including the two 320K disk drives, but not including the QuadBoard, display and printer, or the adapter for them). This seemed a very reasonable price (it was 20 percent less than the price of a new pc with the same equipment), but the discounters had finally gotten into the IBM-pc business in New York.

"I can get a new one at Weird Zero's Electronics for $2,350 with an IBM monitor," said some. "Whyn'tcha drop your price?"

One gruff-sounding chap said he wanted to buy "a toy to play with, you know, one of them IBM pcs." I hung up on him.

A few callers were serious. One man came out from Queens and got a free two-hour pc tutorial. I was convinced he would buy. He said, "I'll let you know," as he left. I was wrong.

The ad stopped running, and I started panicking. By now I could almost taste the XT, but my pc was still where it had been, and so was my wallet.

Then one night I arrived home to find three messages on the telephone-answering machine, all from the same man. The first message was blank. The second one explained that the blank message was from him, gave his name, and said that he was very interested in the pc. The third message included his phone number.

I said to my wife, "This guy needs a computer just to get himself organized!"

He came by the next evening and was, indeed, serious. He'd been to Weird Zero's and wasn't happy with the outcome of the trip. He tinkered around with my pc, was satisfied that it was all there and working, and offered to stop at my office the next day with a deposit for it.

I called ComputerLand in the morning. "We've done it!" I said.

"Good," was the reply. "What have we done?"

"It's sold—at least if this fellow shows up with the check—the pc is sold."

"Well that's nice—I suppose that means you want your XT today?"

"No, tomorrow night will do fine. I can't leave early today," I replied.

"You're always so good to us, John. There's one small problem, though," he said. "Getting the Shugart half-heights turned out to be difficult." They had been on back-order since the display models had been delivered, and no one knew when shipments might arrive.

Planning the Move. I did a lot of thinking about moving to the XT and tried to plan for it. Since what was originally meant to be a hobby had rapidly turned into a business, this was no small issue. There were really two parts to the move. The hardware was one part. Changing from the DOS 1.1 operating system to DOS 2.0 was the other. Both gave me lots to think about.

While the XT is supposed to be fully upward-compatible with the pc, it is different enough to bring out the skeptic in me. I bear the scars of many "upward-compatible" hardware moves in the mainframe and time-sharing worlds. I was convinced that there could be as many significant problems in this move as any other that I had been through. Like the hardware, DOS 2.0 was touted by IBM as being fully upward-compatible with DOS 1.1. But my software scars (they're smaller, but more numerous) began to itch whenever I thought about the change.

I speculated that the change in operating systems would be the most significant difference in the move, but I had no choice about doing it. Unless an XT user decides to ignore ten megabytes of high-speed Winchester disk storage (a doubtful choice, to say the least), the machine requires DOS 2.0.

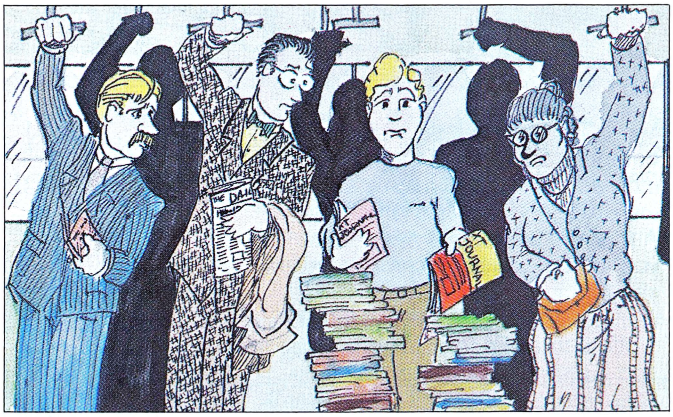
The system looks terrific on paper, with plenty of new and enticing advanced features, but I had tried 2.0 on the pc and hadn't been convinced of its usefulness. It required too much memory compared to DOS 1.1, and the disk-resident operating system commands required more space than was reasonable (even with the nine-sector format). In addition, the hierarchical disk directory scheme, while theoretically useful and well conceived, was a cumbersome and space-consuming nuisance on floppy disks.

My attempts to use DOS 2.0 regularly on the pc ended when I found out that I couldn't fit a version of my favorite DOS/Basic Interpreter/Basic Compiler combination disk on one of the DOS 2.0 360K disks. The day that happened I labeled my DOS 2.0 library box "TEST" and put it back on the shelf.

The only program I had used regularly on the pc with DOS 2.0 was IUS's *EasyWriter II.* I had sufficient memory for DOS 2.0, a 160K RAM disk, and the 96K version of *EasyWriter II.* Only a small subset of DOS disk-resident commands is usually required for use of the program, and the extra disk real estate for storing my documents had been most welcome.

My experience with DOS 2.0 was, therefore, minimal. I had used it in only one environment and had taken advantage only of its disk storage enhancements. I had not used any of its advanced features and probably couldn't even name many of them. I needed a fast education!

In the week before I picked up the XT I read as much of the DOS 2.0 manual as I could absorb; I digested all of Alan Boyd's "System Notebook" columns in *Softalk;* and I scanned every recent issue of the pc-oriented magazines for any DOS 2.0 hints I could find. I reread Peter Norton's *Inside the IBM-PC,* looking for further DOS 2.0 clues. The August issue of *Softalk* came in the mail that week with reader Morton Kaplon's letter entitled "DOS 2.0: One Man's Story"; Kaplon's letter proved itself a lifesaver.



My only remaining concern was the DOS 2.0 linker. Like most of DOS, it had been rewritten for the new system and was supposedly faster and more efficient. It was certainly the only disk-resident command that didn't become larger than its DOS 1.1 counterpart. But I wondered if it would produce the same results as the DOS 1.1 linker.

To find out, I compiled one of my larger production programs using the IBM Basic compiler under both DOS 1.1 and DOS 2.0. The object modules were identical, which should not have been a surprise—after all, a compiler is just another application program and IBM had promised compatibility at that level.

After I had used the linker program from each system, however, the *diskcomp* command indicated that the executable (.exe) files were different! Norton's *Romcomp* program (designed to compare different versions of the IBM ROM chips) provided a quick way to

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compare the .exe files. There appeared to be a one-byte difference in one of the first (signature) records of the files that got carried along through the rest of the header information. But there were no discernible operating differences in the programs. My experiment included running each version of the program under both operating systems. Everything seemed to be fine.

My experiments could not be considered complete or foolproof, but time was getting short. Besides, with the Shugart half-heights installed on the XT (if they ever arrived) I would be able to go back to DOS 1.1 if insurmountable problems arose.

I still had to face the complexity of DOS 2.0's hierarchical directory scheme.

By chance I had a lunch date that week with a friend who works in one of IBM's New York customer service groups. It turned out that he had recently been keeping several XTs and their Winchester disks synchronized at various IBM offices throughout the city.

Dealing with Directories. "It's simple," he said. "Just set up your directories and write batch commands to move yourself around and set up your paths." (A *path* is a route you instruct DOS 2.0 to take when looking for a command not found in your current directory—see "System Notebook" in the May and June issues.)

Sheer genius! I began scribbling away in my notebook on the train home that night. I decided to keep most disk-resident operating system commands in a directory called DOSRES. Other universally needed commands and programs would be kept in DOSRES as well. For example, my initial planning included keeping IBM's *Personal Editor* in DOSRES. Kaplon's warning about hiding the *format* command (to prevent accidental erasure of the Winchester disk) gave me the idea to keep some of the DOS commands, including *format,* stored in a directory called NONRES. DOSRES would always be on a path for the current directory. NONRES, on the other hand, would never be on a path.

I planned to assign other directories on the Winchester by function. Basic would be housed in a directory called Basic. Resident files would include the Basic and BasicA .com files, as well as the Basic compiler .exe and .lib files. Also included would be batch commands I regularly used to start the interpreters and the compiler, in addition to the Basic program I used to define function keys and set up the printer. I normally used *Personal Editor* for working on Basic programs, so the appropriate profile (Pe.pro) and help (Pe.hlp) files for that program would also be resident in the Basic directory. The *path* command only directs DOS to commands (.exe, .com, and bat files), not to data. The Pe.pro and Pe.hlp files are data files and are not seen by DOS when following a path. Application development areas needing Basic would each have their own directory, and the Basic directory would be on a path for them to use.

EasyWriter II, Pascal, the *Macro Assembler,* and other application and language areas would each have their own directories (named EWII, Pas, Asm, and so on). My software production directories would include both test and production subdirectories, and each of those would have source and execution subdirectories. The appropriate compilers would be available on a path.

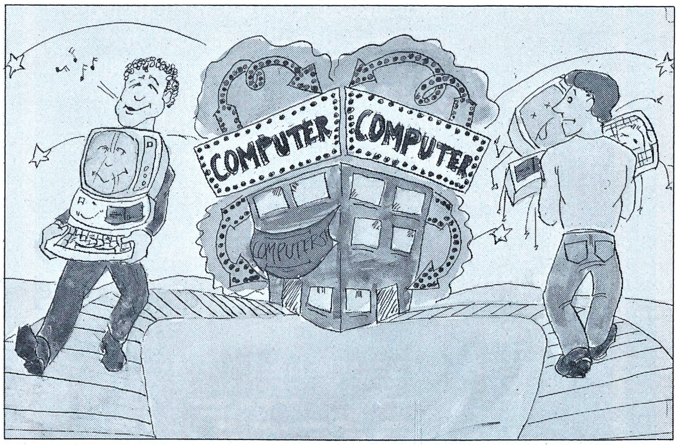
Each directory (except NONRES) would have an associated batch command of the same name. The command would change the current directory to the target directory (for example, Basic.bat would change the directory to be the Basic directory—see listing 5), and would establish appropriate paths for that particular function. A path to DOSRES was a requirement for all directories, and other paths would be established as needed. The batch commands for directories with subdirectories would be more complex and would require the advanced features of the DOS 2.0 batch facility. I was looking forward to trying them out.

The Great Day Arrives. By the time the great day arrived, I was as ready as I could be. I would have felt better had I planned out every last detail, but at least I was comfortable enough not to be nervous about moving to the XT and DOS 2.0.

I arrived at ComputerLand at about six o'clock that evening, dinner time for people with good sense. "Say 'Thank you,' " I was greeted.

I looked around quizzically and then noticed the hole in the XT display model where the Shugart half-heights had been. I smiled. "We decided to give them up for you. What's the sense of displaying them if you can't get them?" The Shugarts were being guaranteed as new, so their prior service as demos didn't matter.

ComputerLand's resident "tech" was working on my XT when I got there. The half-heights were installed and he was starting to work on the system board and expansion cards. (IBM delivers the machine with 128K installed, and I was having it upgraded to its full 256K capacity.) I wandered back into the tech area, expecting to pick up my new machine and go home to try it out, but the normally cheerful tech looked grim as he peered at the display hooked up to the XT. He was silent.



"Problem?" I asked.

"Won't boot from the Winchester," he replied sullenly. "The diagnostics are fine. It just won't boot."

My heart sank as I watched my old pc leave with its new owner. I cheered up when the tech said, "I'll get another one out." The tech didn't get any cheerier, however. Setting up and testing an XT is a lot of work, and he had to do it all over again. This time he installed DOS 2.0 on the Winchester and booted the XT before installing everything else. It worked fine, so he took it apart and put all my pieces in.

After reassembling the machine and running the diagnostics, he had me try it out. At first I thought the messages on the screen were error diagnostics being displayed during the power-on self-test, and I got nervous. "What're those?" I asked the second time I switched on the XT and saw them. "It's just telling you how much RAM is in the machine," he assured me. No one had told me that the XT displays a countdown of memory as it checks itself out.

ComputerLand installed a copy of the *Shipdisk* utility on my Winchester. IBM distributes it on the technicians' service disk (advanced diagnostics) for use when delivering Winchester disks. Running it causes the heads to move to cylinder 304 (all the way in, where you'll probably never store data) and stop. With the heads in that position, damage to your data is unlikely even if a head crash should inadvertently occur. I was advised to run the program whenever the machine would be left off for a while and whenever there was a possibility that someone might give it a hard bump. The same program is available on the Version 2.02 diagnostic disk provided

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with the XT, but having it available separately is a nice convenience. "Be sure you plan to bring the machine down," I was warned. "It goes into a deep sleep after you run *Shipdisk*, and you'll have to shut it off to reboot."

It was very late (the store was officially closed) by the time we settled up the paperwork. I happily drove home with the XT nestled comfortably in the back seat, placed it where the pc had lived until the night before, hooked it up, and switched it on. Everything seemed fine. The XT starts up faster than the pc even before you've initialized DOS 2.0 from the Winchester disk, and I liked that. I ran the diagnostics and, again, everything was okay.

I decided to bring up DOS 1.1 before turning in for the night. Mounting my usual working boot disk in the A drive, I pressed control-alt-delete to start things off. One thing was immediately apparent—there was no noise from the floppy disk drive. I looked to see if the drive's light was on; it was. The Shugarts are nearly silent in operation, a welcome change from the buzz-saw sounds of the IBM drives.

But the Drive Wasn't There. The second thing I noticed wasn't quite so pleasant. I watched as the screen showed DOS 1.1 come up and execute my usual Auto.exec.bat file without a hitch. Then I ran *chkdsk* to see if the Quadram RAM disk (drive C) was there. The "Invalid Drive Specification" error message came on the screen. A quick check (using *chkdsk* again, this time on the A drive) showed that the memory I had assigned to the RAM disk was unavailable (as it should be), but the drive itself was not there. I rebooted the system, just to be sure, but got the same results.

I installed Quadram's *QD* (that stands for *QuadRAM Drive*) program on the Winchester to bring it up under DOS 2.0. I got the same results—no memory, no RAM disk. I didn't need to write myself a note to remember to call Quadram in the morning. I had used the *QD* program with DOS 2.0 on the pc, so something related to the XT hardware had to be amiss, and I wanted to know what it was and how to fix it.

The man I spoke with at Quadram assured me that the problem was DOS 2.0, not with the XT. He said I should notice that twice as much memory was being used but that the RAM disk was not present. I assured him that I was having a different problem and that I was sure it wasn't because of DOS 2.0. He suggested I get the latest copy of the *QD* program from my dealer and told me I should be using *QDXT* for DOS 2.0. *QD*, he explained, was only for DOS 1.1 and would work with that system on the XT.

The software delivered with my QuadBoard had not included *QDXT*, and I asked the man at Quadram when they had started shipping the newer programs. "Recently," he replied. I was getting confused. My board was less than three months old, and I wondered how they defined "recently" at Quadram.

I picked up a copy of the new Quadram software and proceeded to try it out. The bug that had been described to me by Quadram popped right up when I used the newer *QD* program on both DOS 1.1 and DOS 2.0 on the XT. A capacity of more than 320K was not available, and there was no 160K RAM disk to account for it.

I tried the *QDXT* version of Quadram's program. This time I had a RAM disk under DOS 2.0. There were two remaining problems, however. I had the same bug when using the program under DOS 1.1 as I did with the newer version of *QD*, so I couldn't use the *QDXT* RAM disk there. In addition, the RAM disk that was available under DOS 2.0 was designated as drive C, and the Winchester (which is normally drive C) had been pushed down to drive D. Quadram's documentation indicated no way to change this. I thought of using the DOS 2.0 *assign* command. However, if you use *assign* (which is disk-resident) to reassign the drive with your disk-resident system commands on it, there is no way to get it back. So much for that cure!

It was the weekend by now, so I couldn't call Quadram for help (a call later in the week brought news that there was no way to change the drive designation of the RAM disk and that none of the programs worked with DOS 1.1 on an XT). I picked up the August *Softalk* and reread Kaplon's letter. Installing the IBM RAM disk device driver program (published in the DOS 2.0 manual) didn't sound too bad, and might even be fun. By this time I had defined some of my Winchester's directories, including Asm (for the IBM *Macro Assembler*). It was time to try them out.

Kaplon had advised users implementing the program to "type it in exactly as it is printed in the manual." I got my magnifying glass out (the program is in very small print) and did just that. He had assured us that when the program was assembled, linked, and converted by Exe2bin to a binary file, it would be 672 bytes long. Sometime after midnight I discovered that my version of the driver was 720 bytes long. I let it go until morning.

Even though the RAM disk driver program was too long, it seemed to work fine, and the program assigned the RAM disk to drive D, where I thought it belonged. But I was worried about the 720 bytes it used. Then I noticed that the program offsets printed in the manual's listing were different from those in my listing. Only then did I realize that in my zeal to copy everything exactly as printed, I had typed in several macro expansions (the lines with the "+" sign to the left). It was easy to fix, and the program came out the right length. I proceeded to install the double-sided version as well.

With both a single- and a double-sided RAM disk available, I wanted a nice way to configure the XT to use either one. DOS 2.0 looks for a Config.sys file to tell it about such things as device drivers, and I didn't want to be bothered copying the different versions of the Config.sys file that were required. I also wanted to be able to bring up the system without the RAM disk, which would require a third version of Config.sys.

"Config.bat" (see listing 1) became my first opportunity to exercise some of the new DOS 2.0 batch features. By running this program and rebooting the system, I could select and install the RAM disk configuration appropriate for whatever I would be doing. The RAM disk size is specified by passing 0, 1, or 2 (for no drive, single-sided, or double-sided) as a parameter to Config.bat. The program selects the appropriate "xxxxxxxx.sys" file (using the new *if*, *goto*, and *label* facilities) and copies it from the NONRES directory to Config.sys in the root directory of the Winchester (DOS looks for it in the root directory of the disk you are booting from).

Behind the Times. Getting all this working was so much fun that I almost didn't notice the clock problem. The QuadBoard clock/calendar was a day behind and hours short of the correct setting! A call to ComputerLand revealed that they didn't carry the required battery and that it wasn't listed as a replacement part. A look at the Quadram manual reminded me that the battery is recharged whenever the machine is switched on. For the rest of the weekend I switched the XT on and off a lot. By Sunday night the battery appeared to have caught up. Apparently it had gotten discharged from all the handling it received during the move.

As the week went by, however, it became apparent that the clock was losing three to five minutes a day. So I called Quadram again. It turned out that the QuadBoard clock is at the same address as IBM's Winchester disk (210 hex), and every time I accessed the disk the clock setting was being affected. "Recent" shipments had included a patch (a wire soldered across the back of the board that changed the clock address to 310 hex) to fix the problem. It was available as a field fix that could be installed by dealers. When I called ComputerLand, they were, again, unaware of the problem (they looked and found no QuadBoards in stock with a wire across the back), but they agreed to call Quadram and fix the board as specified. (In fairness, I should mention here that 210 hex is not listed by IBM as a reserved memory location in its *Technical Reference* manual for the pc.)

I had moved a copy of *EasyWriter II* on to the Winchester prior to defining my directories. It had started up without difficulty, and its speed was impressive. *EasyWriter II* is a heavily overlaid program, and having the program segments on the more quickly accessed disk yielded dramatically improved performance. Moving a document file folder from a floppy disk to the Winchester made it even faster.

However, after I had defined the EWII directory and moved *EasyWriter II* into it, the program decided that it was not on a system disk—and refused to run. When I booted the XT and ran *EasyWriter II* from the system disk (in DOS 2.0) that I had previously used for the program, everything worked fine, so a backup was available. The DOS 2.0 *EW* update had not yet arrived, so I called the IUS telephone support staff to see what could be done. They responded by sending the new disks via air freight. The new word processor arrived the next day and worked fine.

The Basic compiler and the *Macro Assembler* were working fine in their respective directories. The only problem I had so far had been using the Basic compiler in other directories that had the Basic directory on a path. When you compile a Basic program, you have to have the Bascom.lib file in the current directory. When running a compiled Basic program, Bascom.lib expects the Basrun.exe file (which provides the runtime environment for the program) to be present.

Basrun is an .exe file and would ordinarily be thought of as a command that could be available on a path. In this instance, however, the file is considered to be data, and DOS won't find it unless it's present in the current directory (Basic compiler rules allow it to be on the A disk drive as another alternative). You must keep a copy in each directory where compiled Basic programs will be run. Advanced users will note that this is not true for programs compiled with the O option. For these programs, however, the Basrun.lib file must be in the current directory, or on the A drive, when the linker is run.

The time had come to try IBM Pascal out on my XT. I am a novice user of the compiler, so its priority had been low and, for the same reason, I expected problems. I found them! When called upon to compile a small sample program, PAS1 ran out of memory, and the manual merely said that "Compiler Out of Memory" was an error message. I reconfigured the machine with no RAM disk (and no print spooler, which I had successfully installed by this time), and ran the compiler again with my test program. With over 490K available to it, the PAS1 step worked but PAS2 ran out of memory. The manual was no more helpful this time.

ComputerLand put my call for help on IBM's Customer Support Service (CSS), and we had an answer the next day. This was a known error that had nothing to do with either the XT or DOS 2.0—it occurs on all pcs with large memories. CSS supplied a three-part Debug program for the problem, which I applied. PAS1 was still not happy with the memory size unless I removed the RAM disk (I haven't yet determined exactly how much it needs). PAS2 worked fine. One problem remained. PAS1 requires the Paskey file to be present on the A drive. Use of the *assign* command to direct calls to the A drive to the C drive (*assign A=C*) remedied that problem (that's now part of my Pas.bat program). Paskey has to be present in directories that access the Pascal compiler on a path (this is just like the situation with the Basic compiler).

Was It All Worth It? I was able to continue working on my software business and my writing. The problems that remained were relatively minor in the grand scheme of things. Nothing that happened was bad enough to put me out of business, and that says a lot for the upward compatibility of the XT and DOS 2.0.

The new hardware has operated flawlessly. It has inherited reliability from its smaller pc cousin. The Shugart drives are terrific. There are two of them (I'm sure IBM will market half-heights one of these days), they are quiet, and they also seem able to successfully format disks on which the IBM drives fail. (They'd probably format a bagel if I could slide one into the drive.)

DOS 2.0, clumsy on the pc because of its size, is elegant in its operation of the XT. Perhaps the combination of the Winchester's size and speed and the easy environment provided by the DOS 2.0 hierarchical directory system is all that's required to achieve this elegance. But as I learn more about DOS 2.0, I find more things that I like about the system. The only use DOS 1.1 now gets on my XT is for formatting distribution disks and testing programs for downward compatibility.

The software and hardware vendors, as well as the ComputerLand I dealt with, were all very willing to help when problems arose. If there is a criticism to be made, it's that many hardware and software dealers do not make change and upgrade information readily available to users. You often have to call in with a problem before you find out about changes. At least the dealers ought to be made aware of incompatibilities before users are adversely affected.

Well, it's been a month since the XT came home with me from ComputerLand, and it's time to get back to work on that database application! ▲

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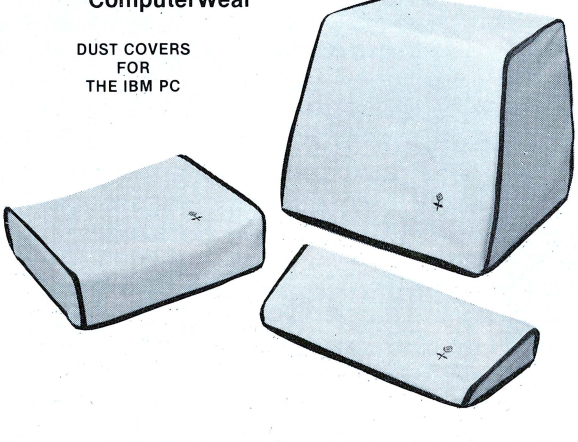

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```
ECHO OFF
IF X%1 = = X ~GOTO ERROR
IF X%1 = = X0 GOTO NORAM
IF X%1 = = X1 GOTO ONESIDE
IF X%1 = = X2 GOTO TWOSIDE
REM
REM No Parameter or Bad Parameter Passed - Error
REM
:ERROR
ECHO ***Error — Must Specify '0', '1', or '2' Sided RAM Disk
GOTO EXIT
REM
REM Set CONFIG.SYS for No RAM Disk
REM
:NORAM
COPY C:\NONRES\NORAM.SYS C:\CONFIG.SYS
ECHO ***Winchester-1 Boot Routine Set for NO RAM Disk
GOTO EXIT
REM
REM Set CONFIG.SYS for One-Sided (180K) RAM Disk
REM
:ONESIDE
COPY C:\NONRES\ONESIDE.SYS C:\CONFIG.SYS
ECHO ***Winchester-1 Boot Routine Set for One-Sided RAM Disk
GOTO EXIT
REM
REM Set CONFIG.SYS for Two-Sided (360K) RAM-Disk
REM
:TWOSIDE
COPY C:\NONRES\TWOSIDE.SYS C:\CONFIG.SYS
ECHO ***Winchester-1 Boot Routine Set for Two-Sided RAM Disk
:EXIT
ECHO ON
```

Listing 1. Config.bat
(Program to change RAM disk configuration)

```
BUFFERS=10
BREAK=ON
```

Listing 2. NORAM.SYS

```
BUFFERS=10
BREAK=ON
DEVICE=C:\NONRES\RAMDISK\IBMDISK1.DRV
```

Listing 3. ONESIDE.SYS

```
BUFFERS=10
BREAK=ON
DEVICE=C:\NONRES\RAMDISK\IBMDISK2.DRV
```

Listing 4. TWOSIDE.SYS

```
ECHO OFF
CLS
PATH C:\;C:\DOSRES
CD C:\BASIC
ECHO
ECHO BASIC Library Area Entered
ECHO Compiler and Interpreter Available
ECHO ON
```

Listing 5. BASIC.BAT

(Typical "change directory" program)

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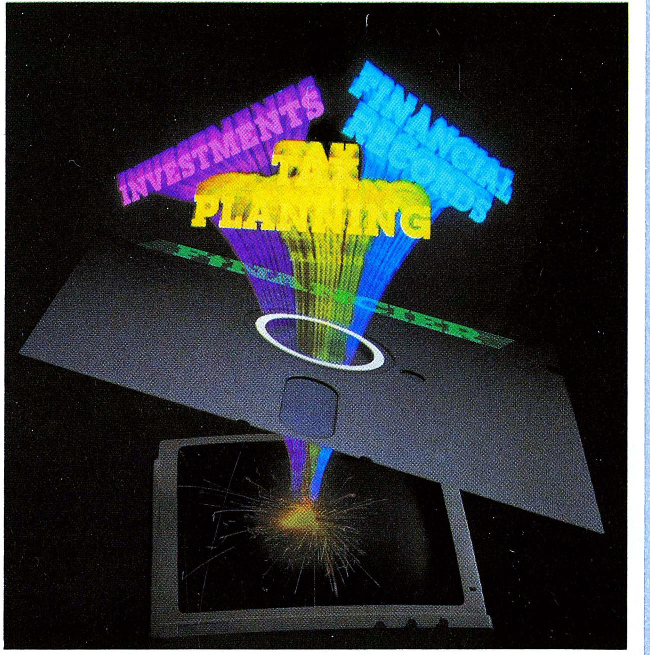

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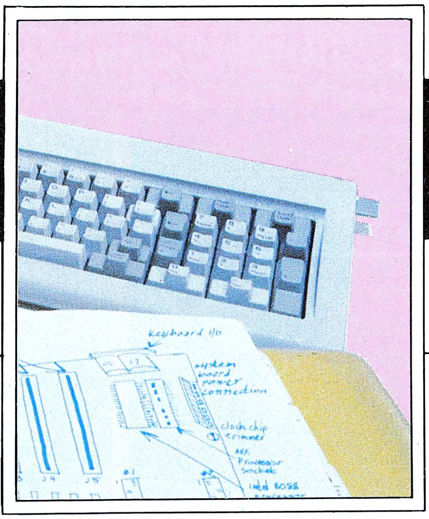

SYSTEM Notebook

by Alan Boyd

DOS 2.0: *Move, Ver,* and *Vol*

Having made our way through most of the new features added to DOS by version 2.0, it's time now to go back and look at the ways in which some of the older, tried-and-true commands have changed.

The changes made to the older DOS commands fall into four categories. In the first category are those commands that, superficially at least, appear not to have changed at all. A quick comparison of the file size of the commands under version 2.0 versus their size under version 1.1 reveals that these commands have become larger. The reason for their growth is improvement in either speed or efficiency. Included in this first category of commands are *sys, diskcopy, diskcomp, date,* and *time.* Since the differences are all transparent to the user, there is no need to discuss them here.

The second category of changes encompasses those commands that make use of filenames or file specifications. Out of DOS 2.0's inclusion of hierarchical directories arises the concept of pathnames, which is obviously going to affect those commands that previously used only a filename. Such commands as *rename, copy, erase,* and *type* have been extended to manage the complexity of full pathnames as well as simple filenames.

Since the only difference in the operation of this second set of commands is the substitution of a full pathname for a simple filename, this second category of commands performs essentially the same as it did under DOS 1.1. Once you understand the concepts behind hierarchical directories, the operation of the commands in this category comes naturally.

As an example, the *copy* command can work between two different directories in much the same way as it has always worked between two different drives. The old version of *copy* was simply:

```
COPY filespec1 filespec2
```

whereas the new version can now include pathnames:

```
COPY [path]filespec1 [path]filespec2
```

To illustrate, let's take a look at this command in its most complex form: copying a group of files from a directory on one drive to a different directory on another drive. If we were to copy all of the .com files assigned the pathname \USR1\FILES\SYSTEM from a directory in drive A to a directory in drive B with the pathname \BACKUP\USR1\FILES\SYSTEM, the full command syntax would be:

```
A>COPY A:\USR1\FILES\SYSTEM\*.COM
B:\BACKUP\USR1\FILES\SYSTEM
```

Now while that might look complex, it follows all the rules of DOS 2.0 we have learned so far.

There are several rules changes and additions to this category of commands, all direct consequences of the new tree-structured filing system. One example that immediately comes to mind is the prohibition against erasing a file that is really a directory: In this case, you must first erase all of the files in the directory and then remove the directory (with *rmdir*).

If you're not using hierarchical directories, you can use these commands exactly as if you were running DOS 1.1.

The third category of changes includes those commands that have had major enhancements. There's no simple way to describe the changes to this set of commands, other than to say that they do more than they did before. We have already seen that the *format* command has been upgraded to handle new types of disk formats. *Format* can now work with either the older eight-sector-per-track format or the new, denser nine-sector-per-track format, as well as with the IBM hard disk. The changes that *format* has undergone under DOS 2.0 are true upgrades to the command itself and take the form of new switches that can be tacked onto the end of the command, switches that were not available under DOS 1.1.

The *chkdsk* command has likewise undergone some major surgery; it now has additional functions.

Yet another command that falls into this category is the amazingly resilient *mode* command. *Mode* is certainly one of the more interesting of the DOS commands. It seems to have been developed as a medium for change. The changes to *mode* between DOS 1.0 and 1.1 implemented a host of new options; the upgrades under 2.0 are an almost staggering leap.

A quick look at the purpose of the *mode* command reveals the reasons behind its accelerated growth. *Mode* was designed to allow users to configure their systems so as to work with many different peripherals.

In its original form, *mode* was a very simple command with two options. The first allowed for printer setup; the second allowed a color/graphics monitor to be configured for forty or eighty properly aligned columns.

Under DOS 1.1, *mode* underwent a transformation that added two new options. The first allowed the asynchronous communications adapter to be properly configured for a host of communications gear, while the second allowed the system to address a serial printer.

Although version 2.0 adds no new options to *mode,* it does make several significant changes. As the pc market matured, IBM took note of the fact that many people were opting for nonstandard peripherals. Although Big Blue's official position is that it does not support any non-IBM-supplied hardware, the company does make it fairly easy to address a variety of nonstandard devices via the *mode* command. As time goes on and more and more people add more and more "strange" new peripherals, you can expect to see the *mode* command upgraded even further. Let's take a closer look at the DOS 2.0 upgrades.

Mode has four major options. The first configures the standard line printer for both character size and spacing. Under DOS 1.1, the generic form of the command was

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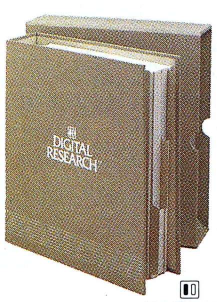

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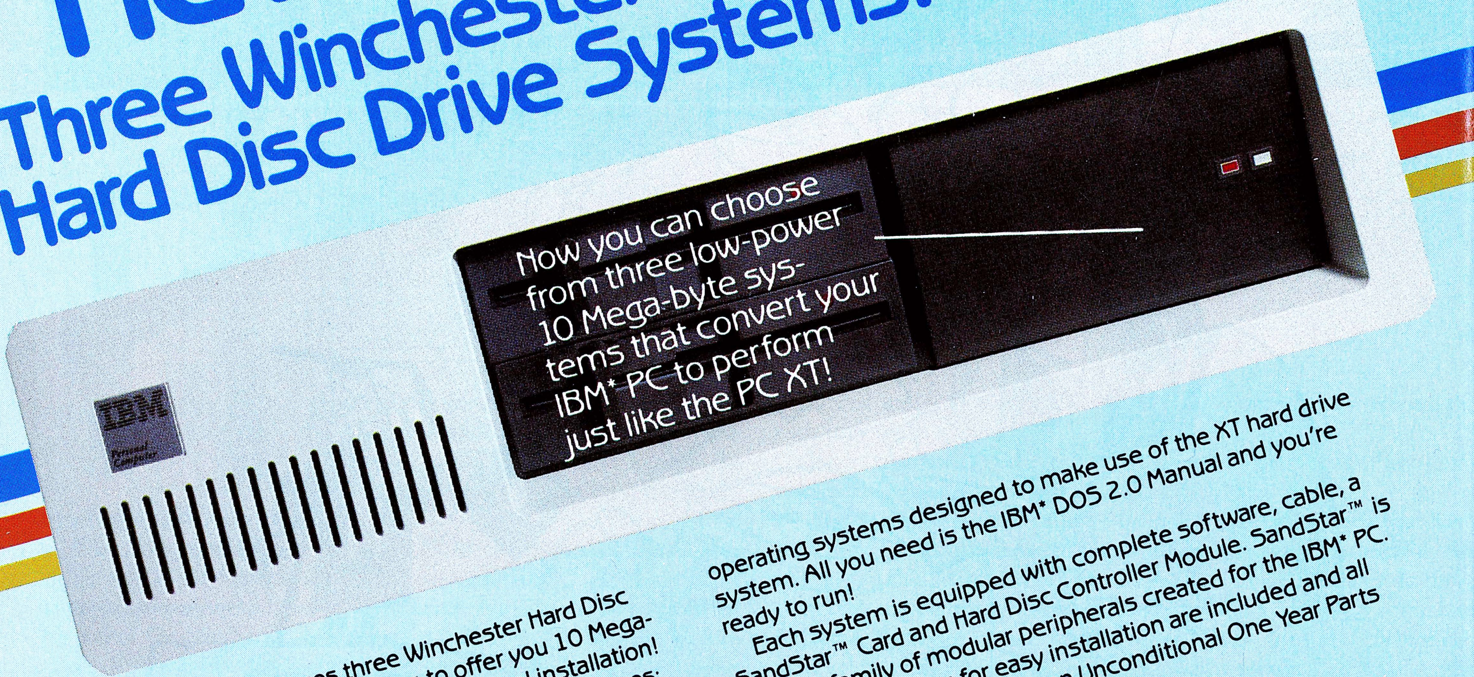

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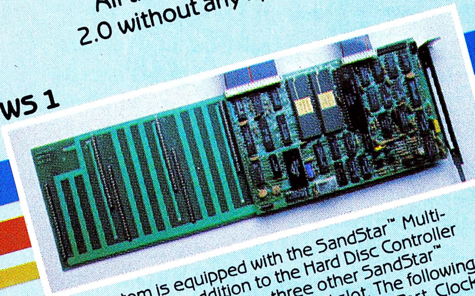

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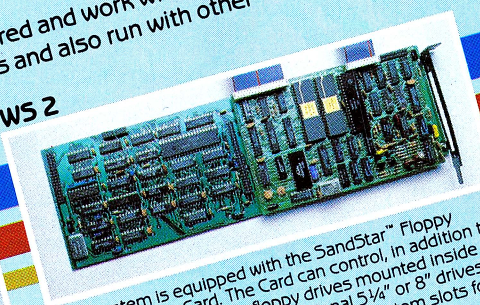

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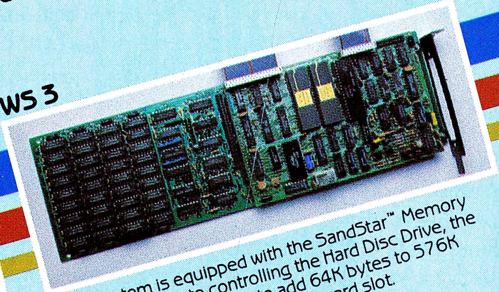

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```
MODE LPT# N,M
```

where # is the printer number (1, 2, or 3), N is the number of characters per line (80 or 132), and M is the number of lines per inch (6 or 8).

DOS version 2.0 adds another parameter to this list. The new option takes the generic form:

```
MODE LPT#:N,M,P
```

The new parameter, P, is not a variable, like the other parameters, but a switch: It is either there or it isn't. Thus you could have the command:

```
MODE LPT1:80,6
```

or

```
MODE LPT1:80,6,P
```

The P parameter is used to override the timeout condition that sometimes causes an error message. The timeout condition occurs when a peripheral device fails to respond to the pc within a predetermined amount of time; in such cases, DOS generates a timeout error message and control is returned to the operating system. Systems that do not have this timeout mechanism frequently hang when data is sent to a device that is not attached or turned on. In such a situation, the computer just sits and merrily waits for the delinquent device to answer. Often the only remedy is to shut down the entire system and restart it, thereby sending all the data that was in memory to the proverbial bit bucket.

For just that reason, DOS makes liberal use of the timeout mechanism. Nonetheless, there may be situations when a user will need to override the timeout system. As a real-life example, consider the case where a user has two printers, one dot-matrix and one letter-quality, connected to the same parallel printer port. Many offices use such a configuration. The dot-matrix printer is used for rough drafts, the letter-quality for final printout.

Many times a user of such a configuration will discover after sending a file to the printer that the printer isn't connected. Rather than have DOS generate a timeout error, the user can turn off the timeout system via the new *mode* option. With the timeout system shut off, DOS will try again and again to send data to the unavailable device. To get out of this retry loop, you can simply type control-break.

The second *mode* command option configures the system for a particular type of display device. The command under DOS 1.1 allows the user to set either a forty- or an eighty-column display mode, to move the position of the characters on-screen to the left or right, and to run a test pattern that facilitates the positioning of the display. The generic form of the DOS 1.1 *mode* command is

```
MODE N,M,T
```

where N is the number of characters per line (40 or 80), M is the direction to shift the display (either R or L), and T is an optional request for a test pattern.

Mode under 2.0 does not include new parameters, but it does enlarge the number of valid options for the N parameter. Whereas before N could specify only forty- or eighty-column operation, new options allow the system to be properly configured for a wide range of display devices. The options for the N parameter now include all of the following:

40	**Same as before, for use in regular 40-column operation.**
80	**Same as before, for use in regular 80-column operation.**
BW40	**For use in a monitor that can only display 40 columns in black and white; turns off the color for a sharper display. This mode is best for small black-and-white televisions that are attached through an RF modulator.**
BW80	**For use in a monitor that can display 80 columns in black and white; turns off the color for a sharper display. This mode is best for black and white, green-screen, or other composite monochrome monitors attached directly to the graphics adapter.**
CO40	**For use in a color monitor or television than can display only 40 columns but also has color capability. This mode is suitable for low-resolution color composite monitors or color televisions attached to the graphics adapter through an RF modulator.**
CO80	**For use in a high-resolution monitor that can display 80 columns in color. In general this will be limited to RGB monitors.**
MONO	**Switches the output to the monochrome adapter, if there is one.**

The new options allow the pc to work with a large number of displays or display devices—all the way from a small black-and-white television set to an expensive RGB monitor. They also allow for the situation in which both the monochrome and graphics card are used simultaneously. It turns out that there are a few applications in which the user can see graphics displayed on a color monitor while entering data using the monochrome display—hence the new *mono* command to switch between displays.

The monochrome display is selected by the command

```
A>MODE MONO
```

which causes DOS to send all screen information to the monochrome display until any of the variations, such as

```
A>MODE CO80
```

are selected.

The reason for having so many options available for display selection has to do with the wide range of display resolutions that the pc can work with. The resolution of a display is indicated by its bandwidth; the greater the bandwidth, the greater the level of detail. Bandwidth, and hence resolution, is more or less directly proportional to cost.

As a general rule, monitors have higher resolution than television sets. TVs can be connected to the pc via a device known as an RF (for *radio frequency*) modulator. An RF modulator converts the signal coming from the pc (which is in a form known as baseband video) into a signal that looks to the TV as if it came over the airwaves. That means the computer signal can be connected to the television antenna, conveniently entering the set the same way a broadcast signal would.

The best way to compare the capabilities of high- and low-bandwidth devices is to attach an RF modulator to the color/graphics adapter and run that signal to a television, while at the same time connecting the composite (direct) video output to a black-and-white monitor and the RGB output to a high-resolution color monitor. The results will be eye-opening: The TV will look fuzzy compared to the black-and-white or RGB monitors. If a color TV is used, rather than a black-and-white set, the differences will be even more pronounced.

If you expect to be doing a lot of work on your pc, it is best to purchase as high a bandwidth display as your budget will allow, since it has been proven that prolonged staring at a low-bandwidth monitor can cause eyestrain, stress, and headaches.

In passing, it's interesting to note the strange situation that occurs when you try to plot two white dots next to each other on a composite monitor. On a nice crisp RGB monitor, two white dots next to each other will always produce exactly that—two adjacent white dots. Try the same on a composite monitor, though, and you'll see a single dot of another color altogether, usually blue or green. This interesting aberration, commonly known as artifacting, is frequently used by clever programmers to write programs that produce stunning colors on a low-cost, low-bandwidth monitor. This is why Microsoft's *Flight Simulator* produces vivid colors on low-cost monitors but only shows black and white on expensive RGBs.

Since the other two uses of the *mode* command—configuring the asynchronous serial port and redirecting the printer output to a serial printer—have not changed, that pretty much completes our discussion of the *mode* command. The only other point that should be made about the *mode* command is that it is specific to the operating system used on the IBM pc. Other MS-DOS systems do not generally contain a *mode* command, and Microsoft does not generally supply it with the operating system; it is left to the manufacturer to write the utility. This helps explain why certain aspects of the *mode* command—the ,P and ,T parameters working as switches without ever being defined as such, for example—do not follow the general rules for DOS commands.

The fourth and by far largest category of changes in DOS 2.0 includes all of the new commands that were not available under earlier versions. Many of the new commands were introduced to work with new features; the hierarchical directory capability, for example, brought with it a whole slew of commands whose purpose is to create, modify, and remove directories. So too have the new I/O-redirection capabilities spawned new commands. We have already reviewed many of the new commands in looking at new features.

The commands that fall into the fourth category include *ver, chdir, mkdir, rmdir, break, verify, path, vol, ctty, set, assign, backup, restore, tree, recover, print,* and *prompt,* as well as the *sort, find,* and *more* filters. There are also several new and exciting batch commands—which we will save for a later time.

When we studied hierarchical directories we looked at the *mkdir, chdir, rmdir, path,* and *tree* commands, and we used the *find, more,* and *sort* filters when we discussed I/O redirection. The remaining commands in this category can be broken down into two classes: internal commands and external commands.

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Internal commands, as you probably remember, are those that are built into the resident portion of DOS and are therefore always available; external commands are stored in disk files and loaded as needed. Excluding the commands we have already covered, the new internal commands include *ver, break, verify, vol, ctty,* and *set,* while the external commands include *assign, backup, restore, recover, print,* and *prompt.* Let's proceed by taking a look at the internal commands.

The inclusion of the *ver* command is a reaction to the confusion that is sure to be generated when three different versions of the same operating system are in simultaneous use. *Ver* is a simple utility that tells the user which version of the operating system is being used.

In point of fact, since *ver* is an internal command, it can only work with version 2.0 and succeeding versions. If you attempt to use the *ver* command with DOS 1, you will be given an error message, meaning that the only information that *ver* supplies is whether you are in version 2.0 or not.

If you are working with 2.0 and enter the *ver* command, you will be rewarded with the copyright notice:

```
IBM Personal Computer DOS version  2.00
```

Notice the extra space between the word *version* and the *2.00;* it's a good indication of the planning for beaucoup future versions of DOS (up to ninety-seven more, if you want to push the point). So look alive: Just about the time you've mastered DOS 2.0, you may be challenged by yet a newer version.

The way the numbering scheme for DOS works is quite simple. The first digit, in this case a 2, represents the version number. Significant changes in the capabilities of DOS must occur before a new version number will be assigned. The two digits after the decimal point represent the release number; minor changes will be indicated by a change in the release number.

You saw this system in action during the earliest days of the pc. The story of how quickly the pc project went from drawing board to dealer shelves is by now well known. Thus it's no surprise that when DOS was released, version 1.00 was soon superseded by 1.05; 1.05 lasted only a few weeks before 1.1 was released.

The hallmark of a new release is that the changes are quite insignificant (from the user's point of view). Between 1.0 and the rarely seen 1.05 there were no apparent changes; the new release simply cleaned up some minor inefficiencies. DOS 1.1 supported double-sided disk drives, and 2.0 supported hard disk drives.

We saw the *vol* command some time ago when we were discussing the new version of the *format* command. *Vol* is a simple internal command used to display the volume label given to a disk during formatting. The /V switch in the *format* command will cause a prompt to be displayed that requests the user to enter a label for the disk; this label is then written onto the disk and is displayed whenever a *dir* or *chkdsk* command is issued. The volume label can also be accessed by application programs to verify that the correct disk is in use.

When invoked, the *vol* command will print out the volume name for the specified drive. If in formatting a disk you assign a volume name of Backup, then invoking the *vol* command will result in

```
A>VOL
Volume in drive A is BACKUP.
```

If you want to check the volume name on a drive you are not currently logged on to, enter

```
A>VOL B:
```

which may result in the message

```
Volume in drive B has no label
```

if the disk was formatted without the /V switch.

Next month we'll continue by looking at several of the new commands that DOS 2.0 brought with it. ▲

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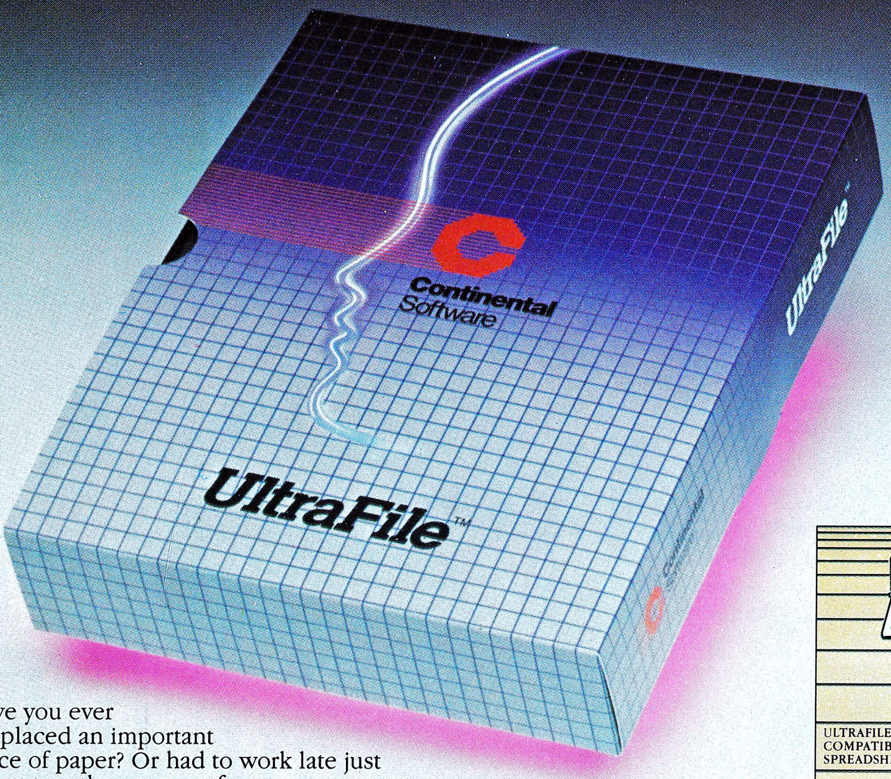

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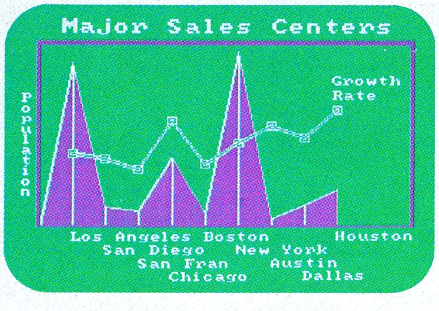

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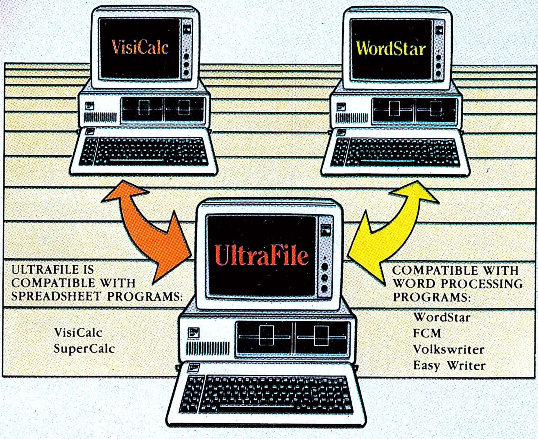
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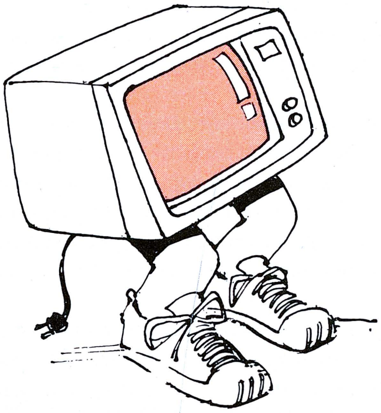

TAMING THE DISPLAY SCREEN

BY HOWARD GLOSSER

This series will give the Basic language programmer easy access to assembly language subroutines that are powerful, fast, and useful. This can be beneficial in several ways. First, you can do things that Basic would take an extremely long time to accomplish (see "From Screen to Dump in Almost 60 Flat," *Softalk*, July 1983). Second, you can do certain things that Basic was not designed for (see "Disk Handler," *Softalk*, October 1983). Both of the programs mentioned overcame Basic's limitations through the use of assembly language subroutines called from a Basic program.

In each installment of this series, a problem will be addressed or a limitation of Basic will be considered. An assembler subroutine will then be presented to solve the difficulty, and a Basic program will be used to poke this assembler routine into memory and then *bsave* it to disk. The subroutine can then be called from any Basic program. A sample Basic program will be presented. We'll discuss a few specific applications, and from there the routine is yours to use and modify. To make this instructive as well as useful, we'll also take a brief look at the assembler code and how it operates.

A Basic Screen Save. In a program, it's often desirable to be able to save temporarily a particular screen display while presenting a different one (such as a help screen or instructions) and then to restore the prior screen display. Although this can be done in Basic, it's time-consuming. The sample Basic program in figure 1 demonstrates just how long it really does take. If you key it in and run it, you'll find it takes Basic about fifteen seconds to save the screen. What actually occurs is that the *def seg* in line 100 points to the monochrome screen buffer. In the *for/next* loop in lines 140—160, the buffer is peeked a character at a time, and the value retrieved is then stored a byte at a time in the array Strscrn%(4000).

Now that you know how long it takes in Basic, let's shorten that time with this month's subroutine, Screen Handler.

Building Screen Handler. The subroutine Screen Handler is designed to save or restore the monochrome display, and at lightning speed! By passing it two values (save or restore and the location of the storage area), you can make the appropriate screen action occur. The demonstration program shows how the subroutine can be used to create an on-screen help facility within a program.

The building of the subroutine is handled a bit differently from the way that's usually done. In this version, the subroutine will actually be stored in a string variable. This eliminates the need for reserving space inside the Basic work area with a *clear* command or having to be concerned about what version of DOS you are using. Once the subroutine is loaded, there's no chance it will get overlaid either.

To begin the subroutine (figure 2), line 120 uses a *def seg* with no value following. This points the current segment to Basic's data segment (where the string variable is stored). The string is defined in line 130 and given the name Subrt$, along with a length of sixty-six characters, which the String$ statement initially sets to all spaces. This is because the string length must be defined and the space reserved for the subroutine before the assembly code can be poked into it. Line 140 uses the *varptr* command to retrieve the location of the string descriptor of Subrt$, which is stored in Sublc%. This string descriptor is a three-character field containing the length of the string in byte 1, and the low and high offset of the string into Basic's data segment in bytes 2 and 3. These last two are used to find the actual location of the string in memory by using the computation in line 150.

```
10 ' This is an example to demonstrate how long
20 '    it takes to use the PEEK statement to
30 '    store a screen display.
40 '
50 CLS:KEY OFF:COLOR 7
60 LOCATE 1,1:PRINT "Start of the screen"
70 LOCATE 8,24:PRINT "An example of using Basic to store the screen"
80 LOCATE 14,6:PRINT "Be patient. . .this will take about 15 seconds!"
90 LOCATE 25,62:PRINT "End of the screen";
100 DEF SEG=&HB000
110 DIM STRSCRN%(4000)
120 LOCATE 25,1:COLOR 31,0:PRINT "Screen is in process of being stored!";
130 COLOR 7,0
140 FOR LOOP%=1 TO 4000
150    STRSCRN%(LOOP%)=PEEK(LOOP%)
160 NEXT
170 CLS:BEEP
180 LOCATE 13,12:PRINT "Screen has finally been stored in STRSCRN%(4000)"
```

Figure 1.

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Once the string's location has been found and stored in the variable Scrn, the *for/next* loop in lines 190–230 pokes the assembly language code located in the *data* statements into string Subrt$. The program checks for errors in the *data* statements; if none are found, the subroutine is stored on disk under the name Scrnhndl by the *bsave* in line 300. Otherwise, the error message in line 260 is displayed and the program stops. Once the subroutine is stored on disk, the work's done. It's then ready to be called from a program, which we'll do in our example.

Content of the Screen Handler Demo. The program to demonstrate Screen Handler (figure 3) creates a simple, usable menu that allows selection of the screen attribute as well as the cursor type on a monochrome display. The program was designed to run under any version of Basic and thus does not use the Advanced Basic key-trap statements. Let's first look at the content of the example, and then we'll discuss how it's used.

At the start of the program the soft-key display (the key definitions that appear at the bottom of the screen) is turned off, and the function keys (F1–F9) are set to a null value. Next, a standard cursor and screen attribute are set. Since this program makes heavy use of the *color* and *locate* statements, it might be helpful to refer to the Basic manual for information on exactly what these commands can do as an aid to using this example.

The variable Loadsw in line 120 keeps track of whether the subroutine has already been loaded. This program can be run many times, and it would be pointless to keep loading the subroutine again and again. In line 160 the *def seg* appears, pointing us to Basic's data segment. Subrt$ is again defined as a string, and line 180 gets the location of the string descriptor. Note, however, that the computation to locate the actual string area is not present at this point in the program. Instead, it is found toward the bottom, on line 1730, as a subroutine that is referenced by a *gosub*. This is because the actual location of string Subrt$ can change while the Basic program is running. This could occur when a fre(" ") command is used to force a housecleaning or if Basic decides to do garbage collection. If this relocation occurred and the program did not recognize that fact, the program would go out to execute the Screen Handler subroutine (where it thought it was) with unpredictable results. So, before any activity such as the *bload* or the subroutine calls is done, the program always does a *gosub* to the routine on line 1730 to find the current location of Subrt$.

Line 240 defines an array variable, Strscrb%, which is 4K in size. This is where the screen image is stored. The variables Store% and Restr% are set respectively to 1 or 2 in line 250, to simplify the call as much as possible. Since this example is supposed to generate an on-screen help facility, the key-press routine beginning on line 1780 recognizes when the F1 key is pressed. In the example program, when F1 is pressed, the screen is immediately saved and a help screen is displayed for the area in question.

Beginning in line 270, the menu for the screen attributes and cursor selection is built. The variable Help% is used to keep track of which part of the program is currently running. It's given the value of 1 in line 390 where we're dealing with the screen attribute, and the value of 2 is assigned in line 540 where we're handling cursor type. When the help screen facility is entered, the current value in Help% determines what help message to print. The actual help screen section begins on line 1000. This is the area of the program where the calls to Screen Handler occur, so let's look at this section in a little more detail.

When this section of the code is entered, the cursor is turned off and its position saved. Line 1090 sets the variable Scrnopt% to Store%, and then the *gosub* retrieves the location of Subrt$ (which contains the Screen Handler subroutine). The actual call then occurs in line 1100. When the help message has been displayed, the user can press any key to return to line 1210. The Scrnopt% variable is set to restore the screen, the *gosub* retrieves Subrt$'s location, and line 1250 calls Screen Handler. After this, the cursor is restored to its prior location and the help section is exited, returning control to line 1840.

Don't Blink or You'll Miss It. The actual operation of the example is very simple. When the program is run, a menu appears allowing selection of the screen attribute. Pressing F1 at this point displays a help screen with further information concerning screen attributes and actual examples of what they look like. To leave the help screen, press any key. This returns control to the menu. At this point, select 1, 2, or 3. Immediately a menu appears, allowing selection of cursor type. Pressing F1 again takes you to a help screen that describes and illustrates what's available. After you return to the menu and select a valid response, the message on lines 800 and 810 is displayed in the selected attribute, and the cursor appears on the next line—in the cursor type you selected. This is positive verification that the selections you made have taken effect. Press *r* to run the demo again or any other key to stop. Try running it a few times to get a feel for what it's doing.

Well, that's the example. Simple, to be sure, but it clearly demonstrates the power and speed of the Screen Handler subroutine. Another suggested use for this subroutine might be a pause key in the middle of a game, where the clock would be stopped and the current screen saved while a pause message or instructions are displayed. Or how about, with some additional work, a programmed split screen, where two entirely different functions could go on at the same time? The possibilities are endless, so experiment with, use, and modify Screen Handler to fit your needs. Now let's move on and take a look at the assembly code.

```
10 '  ***** BUILD SCREEN HANDLER *****
20 '
30 '    STORE/RESTORE SCREEN IMAGE
40 '      ON MONOCHROME DISPLAY
50 '
60 '    WRITTEN BY HOWARD GLOSSER
70 '
80 CLS
90 '
100 ' ** THIS SETS UP STRING LOCATION FOR SUBROUTINE
110 '
120 DEF SEG
130 SUBRT$=STRING$(66,32)
140 SUBLC%=VARPTR(SUBRT$)
150 SCRN=PEEK(SUBLC% + 1) + (256*PEEK(SUBLC% + 2))
160 '
170 ' ** THIS BUILDS THE SUBROUTINE
180 '
190 FOR MEM = SCRN TO SCRN + 65
200    READ DT%
210    POKE MEM,DT%
220    CHECKSUM%=CHECKSUM% + DT%
230 NEXT
240 READ DT%
250 IF CHECKSUM% = DT% THEN 300
260 PRINT "ERROR in DATA STATEMENTS - Check lines 360 - 440":END
270 '
280 ' ** THIS SAVES THE SUBROUTINE
290 '
300 BSAVE "SCRNHNDL",SCRN,&H42
310 PRINT "SCREEN HANDLER SUBROUTINE CREATED"
320 END
```

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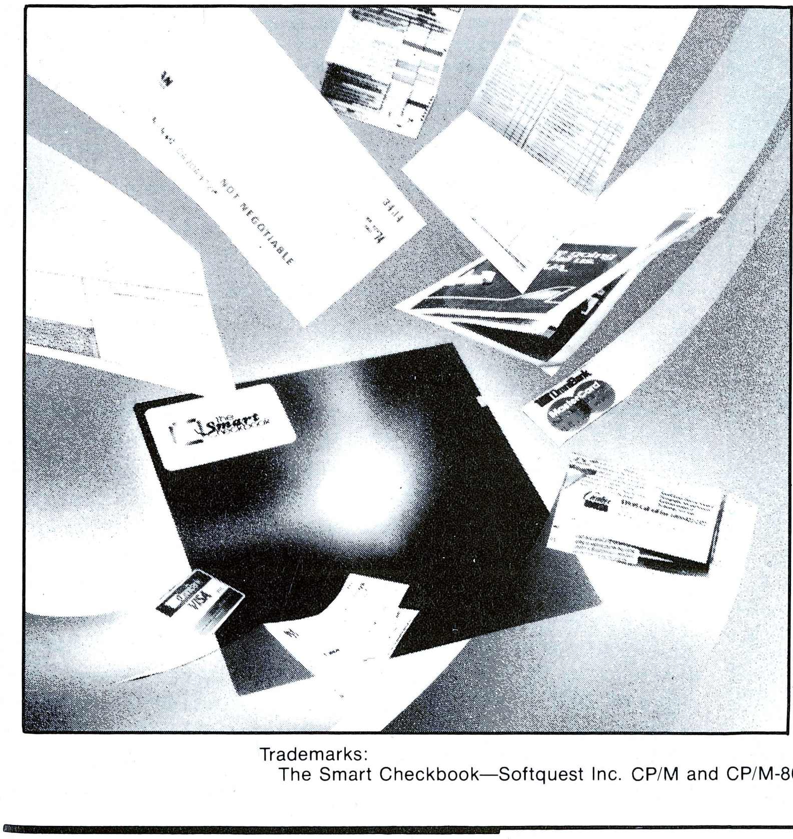

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```
330 '
340 ' ** DATA STATEMENTS TO BUILD SUBROUTINE
350 '
360 DATA &H55,&H8B,&HEC,&H8B,&H76,&H08,&H8B,&H14
370 DATA &H83,&HFA,&H01,&H74,&H08,&H83,&HFA,&H02
380 DATA &H74,&H19,&HEB,&H2A,&H90,&H1E,&H8B,&H7E
390 DATA &H06,&HB8,&H00,&HB0,&H8E,&HD8,&HBE,&H00
400 DATA &H00,&HB9,&HD0,&H07,&HFC,&HF3,&HA5,&H1F
410 DATA &HEB,&H14,&H90,&H8B,&H76,&H06,&H06,&HB8
420 DATA &H00,&HB0,&H8E,&HC0,&HBF,&H00,&H00,&HB9
430 DATA &HD0,&H07,&HFC,&HF3,&HA5,&H07,&H5D,&HCA
440 DATA &H04,&H00,&H1D82
```

Figure 2.

```
10 ' ***** THIS PROGRAM DEMONSTRATES SCREEN HANDLER *****
20 '
30 ' This demonstration of SCREEN HANDLER consists of a screen that allows
40 ' selection of the screen attribute and the type of cursor to use.
50 ' By pressing F1, help is immediately available for the area in question.
60 '
70 '    ** TURN OFF LINE 25 / CLEAR FUNCTION KEYS
80 '       SET STANDARD CURSOR / SCREEN ATTRIBUTES
90 '
100 KEY OFF:FOR X = 1 TO 10:KEY X,"":NEXT
110 COLOR 7,0:LOCATE ,,0,11,12:CLS
120 IF LOADSW THEN 270
130 '
140 ' **** STORE SCREEN HANDLER SUBROUTINE IN STRING
150 '
160 DEF SEG:LOADSW=-1
170 SUBRT$=STRING$(66,32)
180 SUBLC%=VARPTR(SUBRT$)
190 GOSUB 1740          ' get subroutine location
200 BLOAD "SCRNHNDL",SCRN
210 '
220 '    ** DEFINE CONSTANTS NECESSARY IN PROGRAM
230 '
240 DIM STRSCRN%(2000)
250 STORE%=1:RESTR%=2
```

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```
260 SP$=SPACE$(17)
270 '
280 '    ** DISPLAY MENU SCREEN
290 '
300 LOCATE 1,22
310 PRINT STRING$(5,205) " DEMONSTRATE SCREEN HANDLER " STRING$(5,205)
320 LOCATE 2,24:PRINT  "SELECT SCREEN ATTRIBUTE/CURSOR TYPE"
330 LOCATE 4,1:PRINT STRING$(80,205);
340 COLOR 15,0:LOCATE 25,1
350 PRINT "Press F1 for On Screen HELP Facility";
360 '
370 '    ** SET HELP% COUNTER TO KEEP TRACK OF WHERE PROGRAM IS
380 '
390 HELP%=1
400 '
410 COLOR 7,0:LOCATE 7,1
420 PRINT SP$ "SCREEN ATTRIBUTE   :"
430 PRINT SP$ "     1. Regular"
440 PRINT SP$ "     2. Bright"
450 PRINT SP$ "     3. Reverse Video"
460 '
470 '    ** GET RESPONSE AND CHECK VALIDITY
480 '
490 LOCATE 7,39,1:GOSUB 1790:SCRAT%=VAL(KY$)
500 IF SCRAT% ⟩ 3 OR SCRAT% ⟨ 1 THEN SOUND 50,7:GOTO 490:ELSE PRINT SCRAT%
510 '
520 '    ** SET HELP% COUNTER TO KEEP TRACK OF WHERE PROGRAM IS
530 '
540 HELP%=2
550 '
560 LOCATE 12,1,0
570 PRINT SP$ "CURSOR TYPE         :"
580 PRINT SP$ "     1. Regular"
590 PRINT SP$ "     2. Block"
600 PRINT SP$ "     3. Split"
610 '
620 '    ** GET RESPONSE AND CHECK VALIDITY
630 '
640 LOCATE 12,39,1:GOSUB 1790:CSRTYP%=VAL(KY$)
650 IF CSRTYP% ⟩ 3 OR CSRTYP% ⟨ 1 THEN SOUND 50,7:GOTO 640:ELSE PRINT CSRTYP%
660 '
670 '    ** CLEAR LINE 25
680 '
690 LOCATE 25,1:PRINT SPC(40);
700 '
710 '    ** GOSUB TO SET SCREEN ATTRIBUTE
720 '
730 ON SCRAT% GOSUB 890,900,910
740 '
750 '    ** GOSUB TO SET CURSOR TYPE
760 '
770 ON CSRTYP% GOSUB 960,970,980
780 '
790 SOUND 500,1:SOUND 400,1:LOCATE 22,1:HELP%=0
800 PRINT "SCREEN HANDLER DEMO COMPLETED - ";
810 PRINT "Press (R) to run again or any other key to end";
820 LOCATE 23,1:GOSUB 1790
830 IF KY$="R" OR KY$="r" THEN 110
840 COLOR 7,0:LOCATE ,,1,11,12
850 END
860 '
870 '    ** SET SCREEN ATTRIBUTES
880 '
890 COLOR 7,0:GOTO 920   'Regular
900 COLOR 15,0:GOTO 920  'Bright
910 COLOR 0,7            'Reverse Video
920 RETURN
930 '
940 '    ** SET CURSOR TYPE
950 '
960 LOCATE ,,,12,13:GOTO 990 'Regular
970 LOCATE ,,,1,13:GOTO 990  'Block
980 LOCATE ,,,12,1           'Split
990 RETURN
1000 '
1010 '    **** HELP SCREEN SECTION
1020 '    This routine is entered when F1 key is pressed
1030 '
1040 LOCATE,,0
1050 CSR%=CSRLIN:PST%=POS(0)
1060 '
1070 '    ** THIS STORES THE CONTENTS OF THE SCREEN IN STRSCRN%(0)
1080 '
1090 SCRNOPT%=STORE% : GOSUB 1740
1100 CALL SCRN (SCRNOPT%,STRSCRN%(0))
1110 '
1120 '    ** THIS IS THE HELP SCREEN FACILITY
1130 '
1140 CLS:COLOR 0,7:LOCATE 3,27
1150 PRINT " ON-SCREEN HELP FACILITY "
1160 COLOR 7,0:LOCATE 6,1
1170 '
```

```
1180 '    ** THE VALUE IN HELP% DETERMINES WHAT HELP MESSAGE TO PRINT
1190 '
1200 ON HELP% GOSUB 1340,1510
1210 '
1220 '    ** THIS RESTORES THE SCREEN FROM STRSCRN%(0)
1230 '
1240 SCRNOPT%=RESTR% : GOSUB 1740
1250 CALL SCRN (SCRNOPT%,STRSCRN%(0))
1260 LOCATE CSR%,PST%
1270 LOCATE ,,1
1280 RETURN
1290 '
1300 '    **** THESE ARE THE HELP MESSAGES FOR THE DEMONSTRATION
1310 '
1320 '    ** SCREEN ATTRIBUTE HELP
1330 '
1340 SAVHELP%=HELP%:HELP%=0:PRINT "The selection for the ";
1350 COLOR 15,0:PRINT "SCREEN ATTRIBUTE";:COLOR 7,0
1360 PRINT " will result in all data "
1370 PRINT "displayed on the screen being in that attribute. Below are"
1380 PRINT "examples of the 3 screen attributes available."
1390 PRINT "Make your choice on the main menu from these."
1400 PRINT
1410 COLOR 7,0:PRINT SP$;:PRINT "1. ";:COLOR 7,0:PRINT "Regular":PRINT
1420 COLOR 7,0:PRINT SP$;:PRINT "2. ";:COLOR 15,0:PRINT "Bright":PRINT
1430 COLOR 7,0:PRINT SP$;:PRINT "3. ";:COLOR 0,7:PRINT "Reverse/Video":PRINT
1440 BEEP:LOCATE 25,15:COLOR 15,0
1450 PRINT "Press any key to continue. . . .";
1460 GOSUB 1790:COLOR 7,0:HELP%=SAVHELP%
1470 RETURN
1480 '
1490 '    ** CURSOR TYPE HELP
1500 '
1510 SAVHELP%=HELP%:HELP%=0:PRINT "Three different ";
1520 COLOR 15,0:PRINT "CURSOR TYPES ";:COLOR 7,0
1530 PRINT "are included on the main menu."
1540 PRINT "This variety can be used in a number of ways for various reasons;
1550 PRINT "The REGULAR cursor is the default (the flashing line), and is the
1560 PRINT "type of cursor used when Basic is first started, the BLOCK cursor
1570 PRINT "is most effective on a busy screen where the regular cursor is
1580 PRINT "sometimes difficult to spot. The SPLIT cursor proves to be
1590 PRINT "useful on a file maintenance screen where it will wrap around
1600 PRINT "the character being edited. Below are examples of each of the
1610 PRINT "cursor types selectable in the program.
1620 PRINT "Make your selection on the main menu from these."
1630 PRINT:PRINT
1640 PRINT SP$ "1. Regular Line ";:COLOR 23,0:PRINT "−":COLOR 7,0:PRINT
1650 PRINT SP$ "2. Block ";:COLOR 23,0:PRINT CHR$(219):COLOR 7,0:PRINT
1660 PRINT SP$ "3. Split"
1670 BEEP:LOCATE 25,18:COLOR 15,0
1680 PRINT "Press any key to continue. . . .";
1690 LOCATE 22,27,1,12,1
1700 GOSUB 1790
1710 LOCATE ,,0,11,12:COLOR 7,0:HELP%=SAVHELP%
1720 RETURN
1730 '
1740 '    ** RETRIEVE LOCATION OF SUBROUTINE
1750 '
1760 SCRN=PEEK(SUBLC% + 1) + PEEK(SUBLC% + 2) * 256
1770 RETURN
1780 '
1790 '    ** WAIT FOR KEY PRESS ROUTINE
1800 '
1810 KY$=INKEY$:IF KY$="" THEN 1810
1820 IF LEN(KY$) <> 2 THEN 1850
1830 KY$=RIGHT$(KY$,1)
1840 IF ASC(KY$) = 59 AND HELP% <> 0 THEN GOSUB 1000:GOTO 1810
1850 RETURN
```

Figure 3.

Store/Restore Assembly Style. The assembly language subroutine in figure 4 is made up primarily of three parts. Part 1 (lines 15 through 24) is used to retrieve information from the stack, which was passed from Basic, to tell the subroutine whether to store or restore the screen image. The only valid options are 1 and 2; if either of these is found, a jump is taken to the appropriate section of code. Otherwise, the subroutine returns to Basic, with no action taking place.

Part 2 of the program consists of lines 25 through 35 and is entered if a screen store operation is to be done. The DS register is first saved (so later a successful return to Basic can be made). In line 27, information is retrieved from the stack telling the subroutine where to store the screen image. Lines 28 and 29 are used to load the DS register with the address of the monochrome screen buffer. Register SI is set up as an indexing register in line 30. The value of 2000 is loaded into the CX register as the

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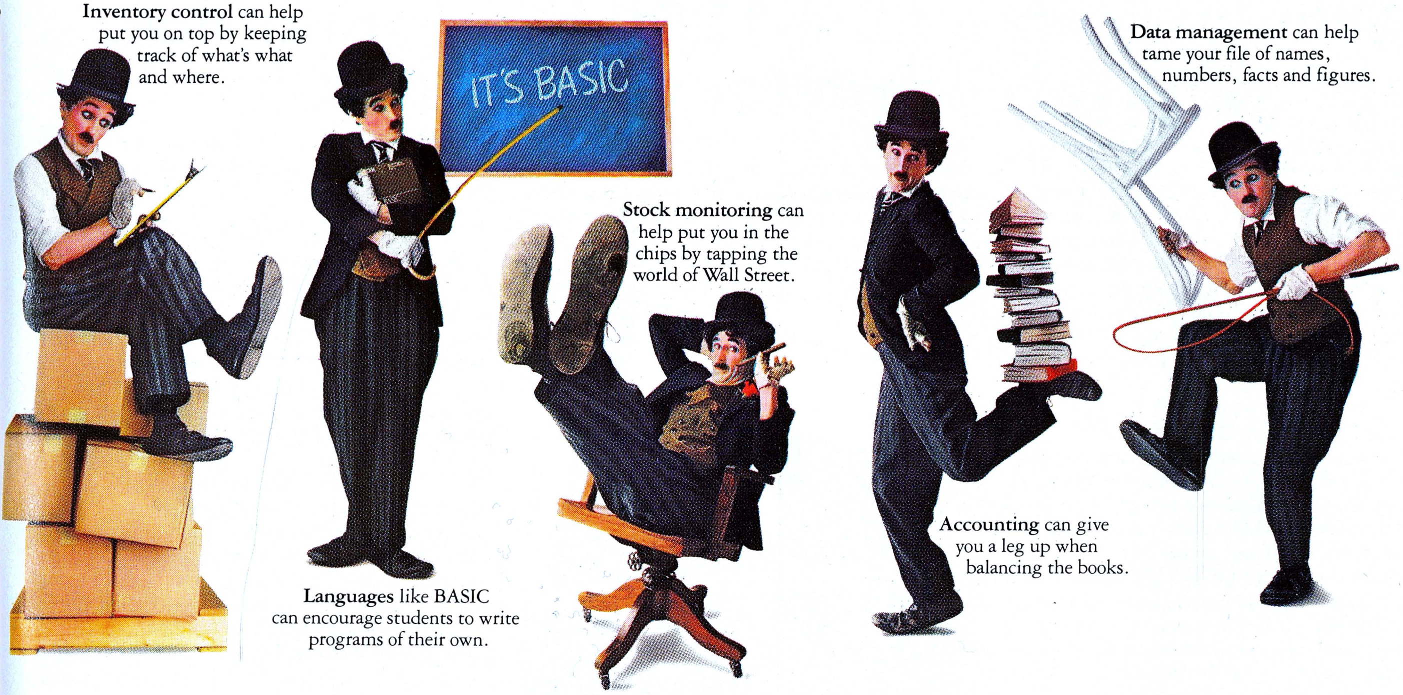

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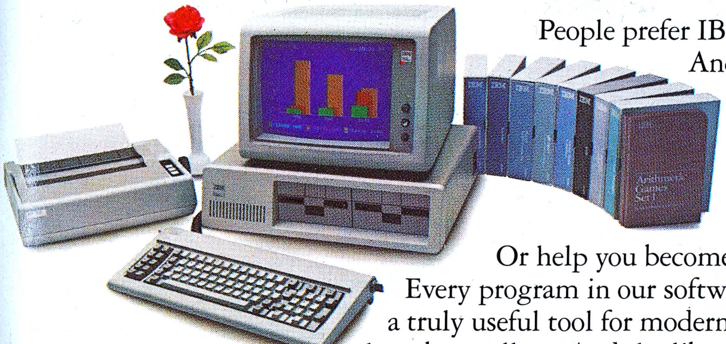

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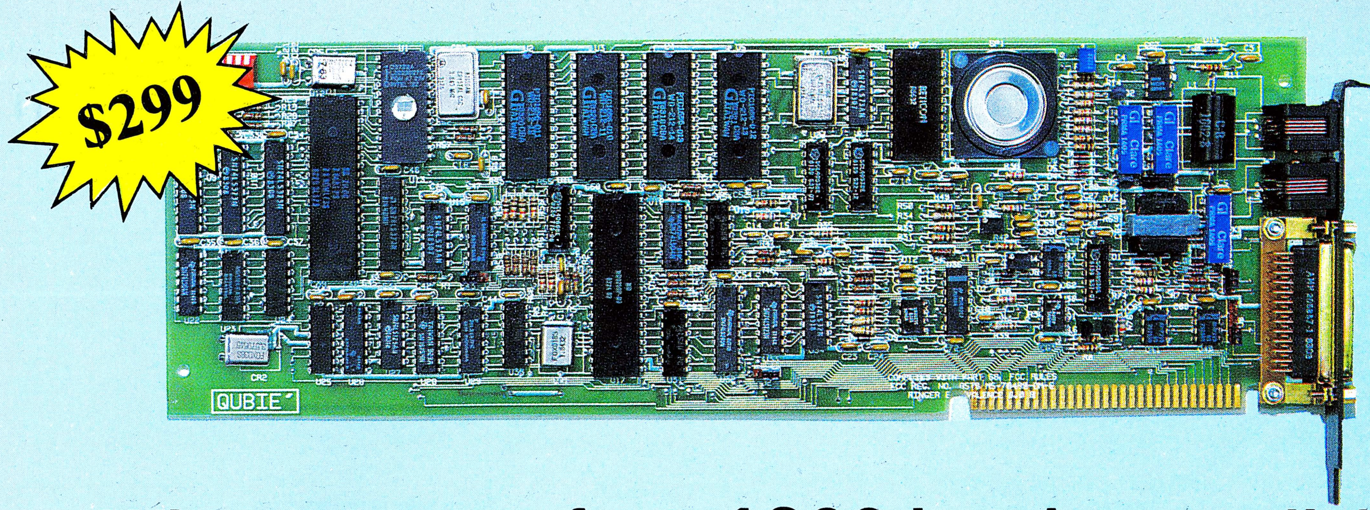

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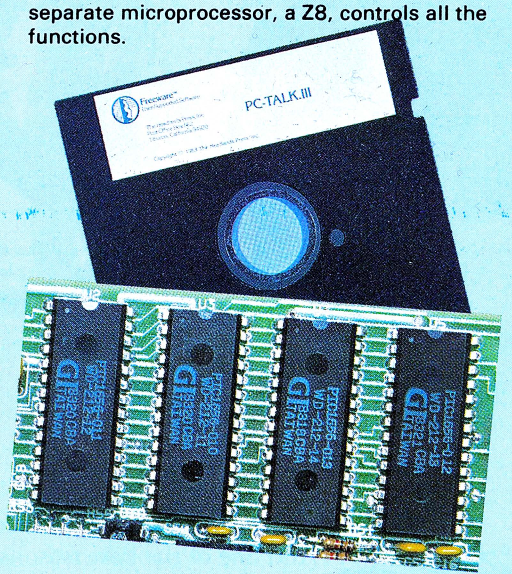

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length of the screen buffer. The buffer is actually 4K in length; however, the move instruction we will use is a word (two bytes) move, and thus two bytes are moved each time instead of just one. The CLD is used in line 32 to assure that the move will go forward from the start of the buffer to the end. The actual work is done in line 33, where the MOVSW instruction is used, moving two bytes at a time from where DS:SI points to the location where ES:DI points (Strscrn % (0)). Note that this instruction is preceded by the REP prefix. This means that the instruction will be repeated as long as CX is not equal to 0—in this case 2,000 times. At the completion of the MOVSW, the DS register is restored, and a jump is made to line 46 for the return to Basic.

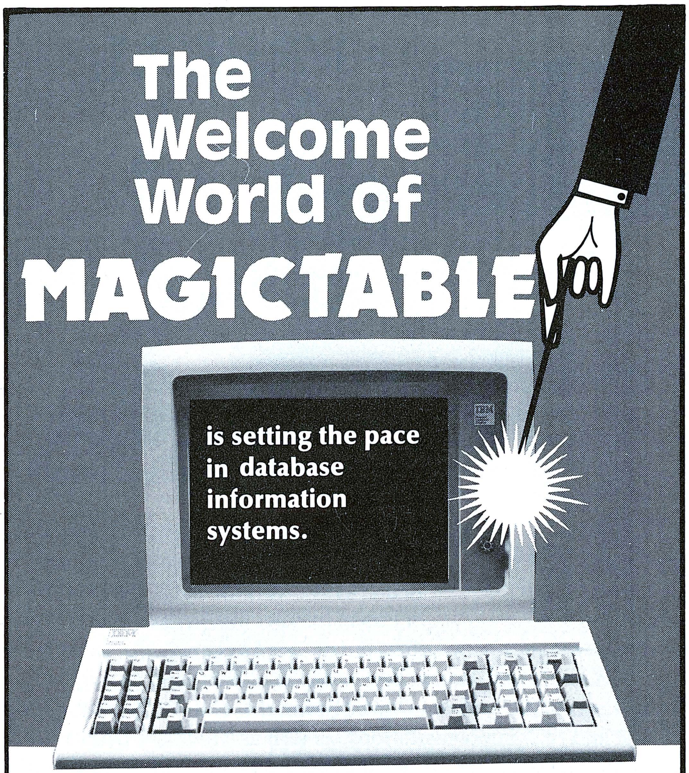
Finally, part 3 (lines 36 through 45) is a restore operation for the screen. The location of the screen storage area is retrieved from the stack and the ES register is saved. This time the ES register is loaded with the screen address. This is because in a move-type instruction the TO location is always the ES:DI register combination. In line 41, register DI is set up for indexing, and line 42 sets CX to 2000 again. The MOVSW instruction with the REP prefix again does the work, and after ES is restored the subroutine again returns to Basic.

If you refer to the first program in this article, and compare the time the Basic screen save took with the time that Screen Handler takes, it's clear how assembly language subroutines can enhance a Basic program.

In the next Basic/Assembly Line we'll take a look at a subroutine that checks input for a valid file name. ▲

```
1                ; SCREEN HANDLER
2                ;
3                ; THIS ROUTINE WILL HANDLE SAVING/RESTORING THE
4                ;    MONOCHROME SCREEN AND IS CALLED FROM BASIC
5                ;
6                ; IF OPTION = 1 THEN STORE THE SCREEN
7                ;
8                ; IF OPTION = 2 THEN RESTORE THE SCREEN
9                ;
10               ; WRITTEN BY HOWARD GLOSSER
11               ;
12 0000          CSEG      SEGMENT
13                         ASSUME CS:CSEG
14               ;
15 0000          SCRN      PROC   FAR
16 0000 55                 PUSH BP            ;SAVE BP FOR FAR RETURN
17 0001 8B EC              MOV BP,SP          ;MOVE STACK POINTER TO BP
18 0003 8B 76 08           MOV SI,[BP]+8      ;POINT SI AT PARM 1
19 0006 8B 14              MOV DX,[SI]        ;GET SCRNOPT% IN DX
20 0008 83 FA 01           CMP DX,1           ;IS IT OPTION 1?
21 000B 74 08              JE  STORE          ;YES - GO STORE SCREEN
22 000D 83 FA 02           CMP DX,2           ;IS IT OPTION 2?
23 0010 74 19              JE  RESTORE        ;YES - GO RESTORE SCREEN
24 0012 EB 2A 90           JMP RETURN         ;INVALID OPTION - JUST RETURN
25 0015          STORE:
26 0015 1E                 PUSH DS            ;SAVE DS FOR RETURN TO BASIC
27 0016 8B 7E 06           MOV DI,[BP]+6      ;POINT DI AT PARM 2 ADDRESS
28 0019 B8 B000            MOV AX,0B000H      ;MOVE SCREEN ADDRESS TO AX
29 001C 8E D8              MOV DS,AX          ;POINT DS AT SCREEN BUFFER
30 001E BE 0000            MOV SI,0           ;POINT TO START OF BUFFER
31 0021 B9 07D0            MOV CX,2000        ;SET CX FOR SCREEN LENGTH
32 0024 FC                 CLD                ;CLEAR DIRECTION FLAG - MOVE FWD
33 0025 F3/ A5             REP MOVSW          ;STORE THE SCREEN
34 0027 1F                 POP DS             ;RESTORE DS REGISTER
35 0028 EB 14 90           JMP RETURN         ;GO RETURN TO BASIC
36 002B          RESTORE:
37 002B 8B 76 06           MOV SI,[BP]+6      ;POINT SI AT PARM 2 ADDRESS
38 002E 06                 PUSH ES            ;SAVE ES FOR RETURN TO BASIC
39 002F B8 B000            MOV AX,0B000H      ;MOVE SCREEN ADDRESS TO AX
40 0032 8E C0              MOV ES,AX          ;POINT ES AT SCREEN BUFFER
41 0034 BF 0000            MOV DI,0           ;POINT TO START OF BUFFER
42 0037 B9 07D0            MOV CX,2000        ;SET CX FOR SCREEN LENGTH
43 003A FC                 CLD                ;CLEAR DIRECTION FLAG - MOVE FWD
44 003B F3/ A5             REP MOVSW          ;RESTORE THE SCREEN
45 003D 07                 POP ES             ;RESTORE ES REGISTER
46 003E          RETURN:
47 003E 5D                 POP BP             ;RESTORE BP OFF STACK FOR RETURN
48 003F CA 0004            RET 4              ;FAR RETURN WITH 2 PARMS IN STACK
49 0042          SCRN      ENDP
50 0042          CSEG      ENDS
51                         END
```

Figure 4.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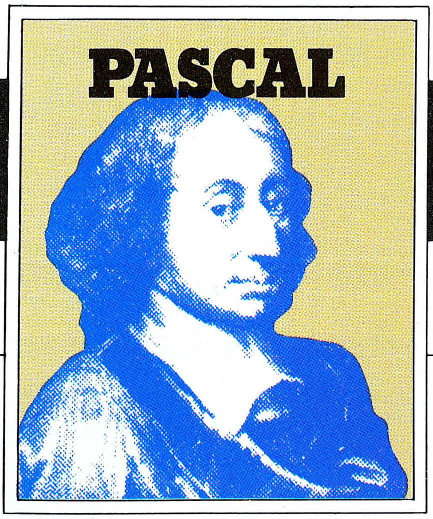

FROM BEGIN TO END

by Bruce Webster and Deirdre Wendt

For the last two months, we've been talking about files and, quite frankly, it's been difficult. Why? Because each implementation of Pascal handles files in its own way. We've made some mention of specifics, but not really enough. So, starting this month, we're going to do our best to explain how to use files under IBM Pascal, Pascal/MT+ (from Digital Research), and UCSD Pascal (both the IBM and NCI implementations, as well as Modula-2 from Volition Systems). For each version, we'll discuss disk file I/O, special textfile functions, random access I/O, device I/O, and error handling. We had hoped to cover this all in one column, but there turned out to be just too much to talk about. This month we'll cover IBM Pascal, followed by UCSD Pascal next month, and Pascal/MT+ the month after that.

Disk Files. IBM Pascal runs under MS/DOS and thus reads and writes regular DOS files. This means, of course, that filenames must conform to DOS standards: an optional drive specifier ("⟨letter⟩:"), the filename itself (one to eight characters), and an optional extension ("." followed by one to three characters). It also means that other programs running under DOS can read your files and vice versa. Several programs out on the market are written in IBM Pascal, including the *Volkswriter* word processing program.

To associate a file variable with an actual file on the disk (or with a file to be created on the disk), we use the command

```
assign(⟨file⟩,⟨filename⟩);
```

where ⟨file⟩ is some type of file variable, and ⟨filename⟩ is a string of some sort (literal, constant, variable) containing the filename. Having used *assign,* we then use the standard procedures *rewrite* and *reset* to open a file for writing and reading respectively. Once we're done with a file, we can close it and save it with the command

```
close(⟨file⟩);
```

If we want to delete the file from the disk, we instead use

```
discard(⟨file⟩);
```

Let's say we've entered data into a textfile using an editor of some sort. Each line has three real-number values on it separated by spaces. These values represent the (x,y,z) coordinates of a star relative to our solar system. We wish to read these values in and write them back out into a *binary* or *data* file for future reference. After we're done, we want to delete the textfile to free up disk space. The text data file is named Stars.txt, and the binary file will be named Stars.bin. Our program might look like this:

```
PROGRAM convert;
CONST
   infilename = 'STARS.TXT';
   outfilename = 'STARS.DAT';
TYPE
   stars       = ARRAY [1..3] OF real;
   { [1] = x, [2] = y, [3] = z }
```

File I/O under IBM Pascal

```
VAR
   infile          : text;
   outfile         : FILE OF stars;
   x,y,z           : real;

BEGIN
   assign(infile,infilename);         { assign to disk files }
   assign(outfile,outfilename);
   reset(infile);                     { open to read }
   rewrite(outfile);                  { open to write }
   WHILE NOT eof(infile) DO BEGIN
      readln(x,y,z);                  { read in values }
      outfile^[1] := x;               { copy to file variable }
      outfile^[2] := y;
      outfile^[3] := z;
      put(outfile)                    { write out to disk }
   END;
   discard(infile);                   { remove text file }
   close(outfile);                    {close and save data file }
END. { of PROGRAM convert }
```

This program opens the file Stars.txt for text input, assigning it to *infile,* and creates the output file Stars.dat, assigning it to *outfile.* It reads data in from *infile* and writes it out (in binary form) to *outfile.* Once it reaches the end of the input file, it deletes Stars.txt, then closes and saves Stars.dat.

Special Textfile Routines. In addition to the standard textfile I/O functions (*read, readln, write, writeln*), IBM Pascal supports a number of extensions. First, formatted numbers can be right-justified (instead of left) by using a negative field width. For example, the statements

```
index := 4323;
writeln('indx =',indx:6,'!');
writeln('indx =',indx:-6,'!');
```

would produce

```
indx =   4323!
indx =4324  !
```

Next, Boolean values can be written and read, appearing in text form as TRUE and FALSE. Enumerated data types (EDTs) can also be written and read, but they appear as their ordinal value. For example

```
PROGRAM io_test;
TYPE
   pascals              = (IBM,UCSD,NCI,MTPLUS);
VAR
   version              : pascals;
BEGIN
   FOR version := IBM to MTPLUS DO
   writeln('version = ',version)
```

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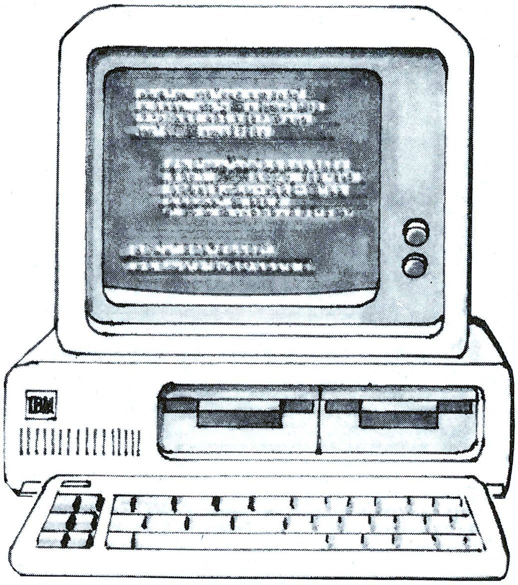
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```
     END.
```

would produce

```
     version = 0
     version = 1
     version = 2
     version = 3
```

since ord(IBM) = 0, ord(UCSD) = 1, and so on. Finally, there are two special input routines. The procedure *readset* reads characters into a string until the string is full or the end of the line is reached. For example, the statement

```
     readset (word,['A'..'Z','a'..'z']);
```

would read the next word in from the keyboard, stopping as soon as it hit a character that wasn't a letter (such as a space or an end-of-line character). The other special routine is *readfn*, which reads in filenames and automatically *assigns* them to file variables in the parameter list. For example, we might want to modify our convert program to read in the input and output file names. We could drop the CONST section and replace the two *assign* statements with

```
     write('enter file names:  ');
     readfn(input,infile,outfile);
```

We could then perform the sequence

```
     A>convert
     enter file names: stars.txt stars.dat
```

and the program would read from and write to the appropriate files.

IBM Pascal will go even one step farther. If we change the program header to be

```
     PROGRAM convert(infile,outfile);
```

we won't need any prompt or assign statements at all. Instead, we need only type

```
     A>convert stars.txt stars.dat
```

and the program will automatically read in the filenames and assign them to the appropriate file variables. Should we forget to include the filenames, then the program will automatically prompt us for them, for example,

```
     A>convert
     INFLE:stars.txt
     OUTFILE:stars.dat
```

All in all, a very convenient feature.

Random Access I/O. Often, we want to read and write data in a file in a nonsequential or *random* manner. For example, having created the file Stars.dat, we might want to be able to retrieve the coordinates of a given star without (1) reading the entire list of stars into memory, or (2) resetting the file and reading through all of the preceding stars to get to the one we want. The ability to directly read (or write) any record in a file regardless of its location is called *random access.*

IBM Pascal allows us to access a file randomly by setting the file mode to DIRECT before opening it. For example, say we wanted to open a "star data" file so that we could read the coordinates for any given star. The program might look like this:

```
     PROGRAM look_at_stars(datafile);
     TYPE
        stars = ARRAY[1..3] OF real;
     VAR
        datafile         : FILE OF stars;
        x,y,z            : real;
        starindex        : integer;
     BEGIN
        datafile.mode := DIRECT;    { set for random access }
        reset (datafile);
        REPEAT
           write('Enter star # (0 to exit):   ');
           readln(starindex);
           IF starindex > 0 THEN BEGIN
              seek(datafile,starindex);   { move to the star }
              get(datafile);                 { and read it in }
              write('Coordinates of star #',starindex:3,':   ');
              write('(',datafile^[1]:12:4,',',datafile^[2]:12:4,
                    ',',datafile^[3]:12:4,')')
           END
        UNTIL starindex <= 0;
        close(datafile)
     END.
```

The *seek* statement moves us to a specific record in a file. The first record is record number one; that is, *seek*(<file>,1) would point at the first record in <file>.

Device I/O. Most applications require I/O involving the computer hardware itself. Reading from the keyboard and writing out to the screen are the two most obvious examples. Standard (and IBM) Pascal predefines the textfiles input and output for just those functions. All *read* and *write* statements without a file variable use these two files. But there are other times when we might want to read from or write to a specific device. How do we do this?

Simple. We use a set of special filenames that refer to hardware devices rather than to disk files. For example, suppose we wanted to run *convert* and enter the data manually instead of having it read from a disk file. We don't have to rewrite the program; we just specify USER as the input file:

```
     A>convert
     INFILE:user
     OUTFILE:stars.dat
```

We then enter the data, line by line. When we're done, we type ctrl-Z<enter>, which tells the program that it's reached the "end of file". By the same token, a program that writes a textfile to disk could be redirected to write the output to the screen.

Here's a list of the special filenames that IBM Pascal recognizes:

USER,CON	**console I/O: read from the keyboard and write to the screen. I/O with CON is buffered by DOS; I/O with USER is not buffered**
LINE,AUX,COM1	**a serial <RS232> port**
PRN,LPT1	**the line printer**
NUL	**a "null" device—that is, anything written to this device simply disappears. Any attempt to read from this device results in an immediate <end-of-file>**

Suppose we've written a program, *decnvrt*, to dump out the data file created by *convert* in text format—three real values per line. We could re-create our original textfile with the command

```
     A>decnvrt stars.dat stars.txt
```

If we wanted to dump the value to the screen, we could use

```
     A>decnvrt stars.dat user
```

while if we wanted a printed copy the command

```
     A>decnvrt stars.dat prn
```

would suffice.

Error Handling. There are few things more irritating than having a program blow up because you entered the wrong filename or because it ran out of space on the disk. Worse yet, the program may go merrily on its way and give no indication of any problem. IBM Pascal allows us to avoid the first problem and gives us the data we need to prevent the second. Remember the *mode* subfield we used to specify a file as being DIRECT? Well, each file variable has two more subfields— *trap* and *errs*—which we can use to handle file I/O errors.

The subfield *trap* is of type *boolean.* It is set to *false* at the start of program execution and after any *reset, rewrite, close,* or *discard* command. If *trap = false,* then any I/O error involving that file causes the program to halt. However, if we set it to *true,* errors will not cause the program to stop. Instead, the subfield *errs* will be given a value in the

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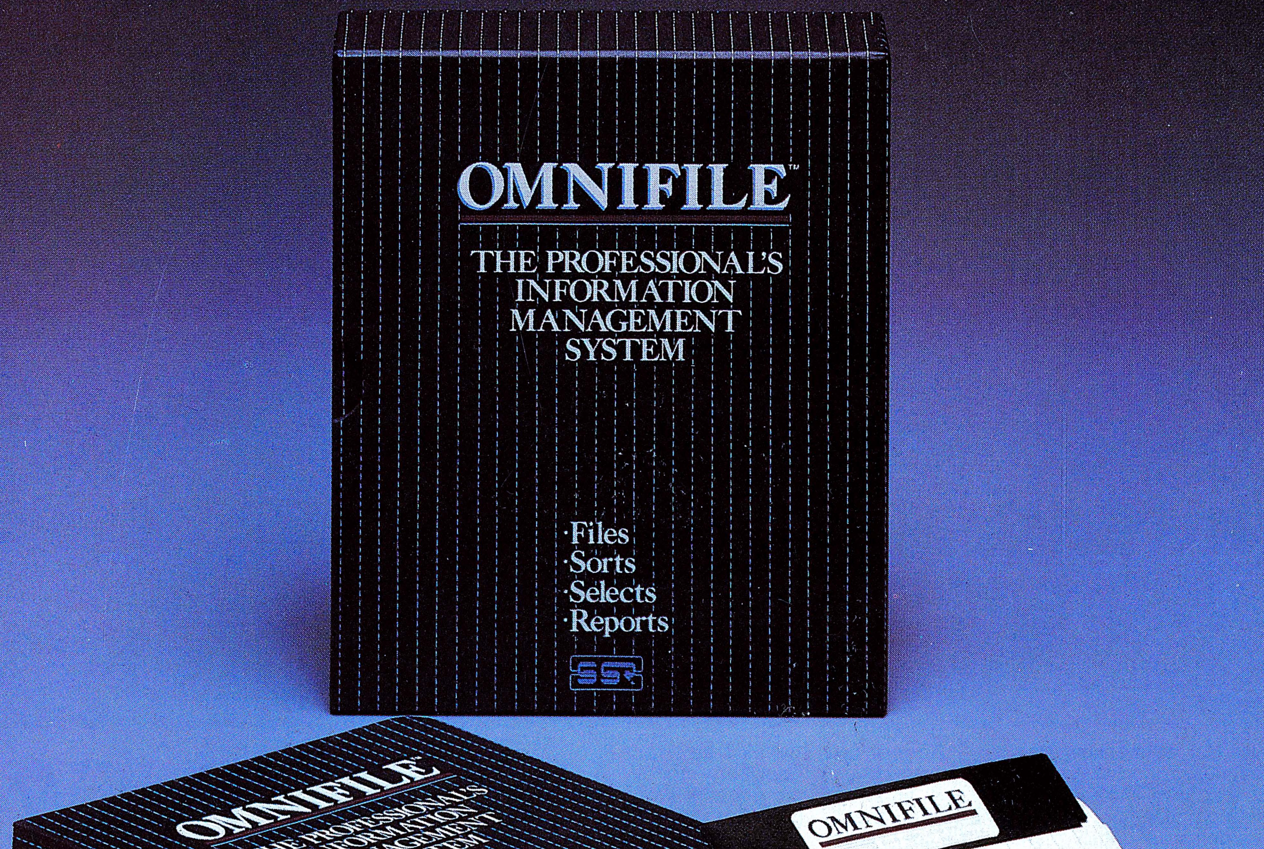

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range 0..15, indicating the nature of the error. Here are the meaningful error codes:

ERROR CODE	MEANING
0	no error
3	invalid operation—for example, trying to open the printer for reading
7	filename error—illegal filename
8	device full—no room on disk, etc.
10	file not found—no such file by this name
13	file not open—you forgot to reset or rewrite, dummy!
14	data format—actual data doesn't match your data definitions
15	line too long

Let's modify our program *convert* to handle I/O errors:

```
PROGRAM convert;
TYPE
   stars          = ARRAY[1..3] OF real;
VAR
   infile         : text;
   outfile        : FILE OF stars;
   x,y,z          : real;
   eval           : integer;

PROCEDURE ioerr(eval : integer);
BEGIN
   CASE eval OF
    0       : { nothing };
    3       : writeln('operation error');
    7       : writeln('illegal file name');
    8       : writeln('no room on disk');
   10       : writeln('file not found');
   13       :writeln('file not open');
   14       : writeln('data format error');
   15       : writeln('line too long');
   OTHERWISE writeln('reserved I/O error: #',eval)
   END;
   IF eval > 0 THEN BEGIN
     REPEAT
        write('A)bort,R)etry: ');
        readln(ch)
     UNTIL ch IN ['A','a','R','r'];
     IF ch IN ['A','a']
       THEN abort('Exiting CONVERT',eval,0)
   END
END; { of PROC ioerr }

{    main body of PROGRAM convert       }
BEGIN
   infile.trap := true;
   outfile.trap := true;

   REPEAT
      write('Enter input file:  ');
      readfn(input,infile);
      ioerr(infile.errs)
   UNTIL infile.errs = 0;

   REPEAT
      write('Enter output file: ');
      readfn(input,outfile);
      ioerr(outfile.errs)
   UNTIL outfile.errs = 0;
      reset(infile);
      infile.trap := true; { need to do this again }
      rewrite(outfile);
      outfile.trap := true; { ditto }
      WHILE NOT eof(infile) DO BEGIN
           readln(infile,x,y,z);
           ioerr(infile.errs);
           outfile^[1] := x;
           outfile^[2] := y;
           outfile^[3] := z;
           put(outfile);
           ioerr(outfile.errs)
      END;
      discard(infile);
      close(outfile)
   END. { of PROGRAM convert }
```

Now our program will do just what we want it to do. If there's an I/O error on one of the files, we'll get the appropriate message and a chance to decide whether to stop execution or continue. The same principle can be applied to all file I/O, including that done via *input* and *output*.

Conclusion. Well, that just about wraps it up for IBM Pascal and file I/O. Next month, we'll tackle the same subjects for UCSD Pascal, including the tuned-up version from Network Consulting (Burnaby, B.C., Canada) and Modula-2 from Volition Systems (Del Mar, CA). The month after that, we'll look at file I/O for Pascal/MT+ from Digital Research (Pacific Grove, CA).

Once we've finished with file I/O, we'll see how these different versions deal with strings and string handling. As always, we welcome comments from you as to what you'd like to see here. Write to us care of *Softalk/IBM*. See you next month. ▲

```
TYPE
   stars = ARRAY[1..3] OF real;
VAR
   datafile        : FILE OF stars;
   x,y,z           : real;
   starindex       : integer;
BEGIN
   datafile.mode  := DIRECT;    { set for random access }
   reset (datafile);
   REPEAT
      write('Enter star # (0 to exit):    ');
      readln(starindex);
      IF starindex > 0 THEN BEGIN
```

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HOW BASIC PARSES PROGRAMS

by John Cole

The verb *to parse* means "to break (a sentence) down into its component parts of speech with an explanation of the form function, and syntactical relationship of each part" (*The American Heritage Dictionary of the English Language,* 1981). In the context of computer language, parsing a program statement means breaking it down into its component keywords, operators and operands and arranging them according to the language's rules of precedence.

In this article we'll take a first look at how the Basic interpreter on your IBM pc goes about doing this essential work.

Let's start with a little review of the three classes of computer languages. Assemblers generally translate one source statement into one machine-language instruction. Compilers translate each source statement into one or more (usually more) instructions, which they then store for later execution. Interpreters do one of two things. They either look at the source code directly and execute it as they see it, or they translate it into an intermediate form, which isn't machine language, and then execute that. The pc Basic interpreters apparently use this latter method.

The intermediate form is the tokenized program described in the article "How Basic Stores Programs," by Gary Little (*Softalk,* August 1983). Each keyword and operator (things such as plus and minus signs) is transformed into a single-byte "token," which is easier for the interpreter to recognize and store than is the original item.

One fact that makes tokens easy for the interpreter to recognize is that, except for tokenized numbers, they all have their high bit set. Tokenized numbers are all below hex 20. Furthermore, hex 20 is a blank and is the lowest-numbered printable character. There are no printable characters with the high bit set. Thus, a number that has its high bit set or that's below the range of printable characters must be a token.

Certain printable characters are themselves tokens—or, in other words, are not tokenized. Variable names and parentheses, among other things, are tokens as they stand.

Some statements are so simple to parse that they are barely worth mentioning. Single keywords that can stand alone on a line, such as *end* or *return,* are the simplest. These are just reduced to tokenized form, and no further analysis is needed.

Statements such as *goto* and *gosub* are a bit more complicated to parse. The interpreter first looks for the line number that must follow these keywords. If the target statement number is not present on the line, or if the line number that is on the line is not actually in the program, the interpreter has to give an error message. Still, this is not particularly difficult.

Statements such as *input, read,* and *print* are rel-

Illustration by Kevin McKeon

atively easy to parse as well, although more difficult to execute. They are relatively easy, that is, unless they're followed by expressions more complex than constants or variables.

This brings us to the parsing of expressions as they're used in *let* and *if* statements (although Basic on the pc allows expressions nearly everywhere). Parsing an arithmetic expression is similar to parsing an English sentence, except that the rules are much more straightforward and always allow a correct interpretation of a syntactically correct sentence—which isn't the case with English. (Consider a sentence like "Time flies." How do you tell which is the verb and which the noun?)

Every Basic expression can be considered to be arithmetic, meaning that it yields a numeric result. This is true even for such relational expressions as 10<5, which, because it's contrary to fact, has the value 0. More about relational operators later.

The computer cannot just look at a statement as you can and pick out the things it wants to analyze first. It scans left to right, and if it wants to go back and look at something, it must first store that something somewhere. Where it stores it is called a *stack*.

A stack is a structure in which the last item on is the first item off. Consider a stack of plates in a cafeteria. Even if there are some already there, new plates from the dishwasher always land on top of the stack, and customers in line always take from the top. In computer terminology, to remove an item from the stack is to *pop* and to add an item is to *push*.

In parsing expressions, the Basic interpreter uses two stacks, one for operands, the other for operators.

Let us consider a simple expression:

```
LET X=Y+Z
```

This statement would be legal even without the *let* keyword, because pc Basic (like most other Basics) is smart enough to recognize that X is not one of its keywords and so would try to analyze the statement as though it started with *let*.

Having decided the statement is a variable assignment, the parser looks for a variable and an equals sign. Obviously you can't assign a new value to a constant, and the equals sign indicates the assignment. Any blanks between the variable, the equals sign, and the assignment expression are ignored for the purpose of parsing.

The rest of the parser's job in interpreting the assignment statement has to do with evaluating the expression that follows the equals sign; our description of that process applies to expressions wherever they may occur.

In the case of the statement *let x=y+z*, the expression to be evaluated is Y+Z. The parser starts by taking the value of the first operand it encounters, Y, and putting it on the operand stack. Then it gets the operator, the plus sign, and puts that on the other stack, the operator stack. Next, it looks for another operand, finds Z, and puts that on the first stack, above the first operand, Y. Then it arrives at the end of the statement.

Now the parser pops the operator stack, getting the plus sign. It applies the plus sign operator to the first two operands it finds on the operand stack. The result of this operation (the addition of X and Y) goes back on the operand stack as a "temporary." This is just a way of saying that the parser stores a result that is not the value of a variable. If the operator stack is now empty (as it is in this case, because we had only one operator—the plus sign), the parser is done evaluating the expression. Quite a bit of work for such a simple statement.

The computer cannot just look at a statement as you can. . . .

Try a more complex example:

```
LET X=A+B*C
```

The parser can't simply execute this statement in left-to-right order, because Basic's rules of precedence require that multiplication be performed before addition (see page 3-29 of the IBM Basic manual for a table of the precedence of operators in IBM's Basic). So, as in the simpler case we just examined, the parser starts by looking for the variable and the equals sign. Then it places the first operand of the expression, A, on the stack. Next it pushes the operator, the plus sign, onto the operator stack. Then it pushes the B onto the operand stack.

At this point, the parser arrives at the multiplication operator. Because this operator has higher precedence than the operator already on the stack (the plus sign), the parser merely pushes the new operator onto the operator stack. Then it pushes the C onto the operand stack.

When the parser reaches the end of the statement, the stacks look like this:

Operands	Operators
C	*
B	+
A	

At this point the multiplication sign is popped from the operator stack and applied to two operands atop the operand stack. The result of this operation, the product of C and B, is pushed onto the operand stack. Now the stacks look like this:

Operands	Operators
[C*B]	+
A	

The bracketed item in the operand stack represents a temporary value—the result of the computation shown within the brackets.

Once again the operator at the top of the operator stack is applied to the top two operands on the operand stack; the sum of A and (C*B) is then pushed onto the operand stack. Since the operator stack is empty at that point, the expression is fully evaluated; the result is on top of the operand stack.

Suppose what you really wanted to do was add A and B, then multiply the sum by C? You would express that request by using parentheses, as follows:

```
(A+B)*C
```

Let's see how the parser handles this.

In scanning this expression, the parser starts by putting the left parenthesis on the operator stack. Then A goes onto the operand stack and the plus sign goes on top of the left parenthesis. Nothing has a lower precedence than a left parenthesis, so any operator will be stacked on top of one. Here's how the stacks look now:

Operands	Operators
	+
A	(

Now the B goes onto the operand stack, and then the right parenthesis is added to the operator stack.

Operands	Operators
	)
B	+
A	(

The arrival of the right parenthesis causes everything on the operator stack to be popped and executed—down to the matching left parenthesis. After popping, the operator stack is empty and the operand stack has, as a temporary result, the value of A+B.

Now the parser stacks the multiplication sign on an empty operator stack and puts the C on top of the temporary result. The stacks look like this:

Operands	Operators
C	
[A+B]	*

As before, the operator atop the operator stack is applied to the top two values on the operand stack—and we're done.

The two operations we've looked at so far, addition and multiplication, are commutative, which means that it doesn't matter what order they're done in (A plus B gives the same result as B plus A). For a little more complexity, let's look now at subtraction and division, which are noncommutative; we'll also throw in a second set of parentheses.

Consider this expression:

(A−B)/(C+D)

The parser starts by stacking the left parenthesis as an operator and the A as an operand. The minus sign, having higher precedence, is then stacked above the parenthesis. Now the B goes onto the operand stack, and the parser, having come to the right parenthesis, is required to pop everything from the operator stack down to the matching left parenthesis. Before it does so, the stacks look like this:

Operands	Operators
	)
B	−
A	(

To carry out the subtraction, the parser knows that it must put the top operand, B, into one "accumulator" and the bottom operand, A, into another—and then perform the operation in reverse order; that is, it knows it has to take the value of B away from that of A, and not vice versa (an accumulator is just a place within the machine where values to be used in a computation, or intermediate results of a computation, are held).

After the subtraction is done, the result is stacked as a temporary on the operand stack. The division sign is placed with the operators, and the left parenthesis is stacked atop it—because left parens are always stacked. At this point, our stacks look like this:

Operands	Operators
	(
[A−B]	/

Now the C goes on top of the temporary in the operand stack, and the plus sign is stacked on top of the left parenthesis. D is put on the top of the operand stack, making the stacks look like this:

Operands	Operators
D	+
C	(
[A−B]	/

Function calls present yet another facet of expression analysis.

The appearance of the right parenthesis now causes the operator stack to be popped down to the left parenthesis, and the result is another temporary on the operand stack:

Operands	Operators
[C+D]	/
[A−B]	

Arriving at the end of the statement causes the parser to carry out the division, and, just as when it was subtracting a moment ago, the parser knows that division is noncommutative and therefore reverses the order of two temporaries on the operand stack.

Function calls present yet another facet of expression analysis. They are treated as high-precedence operators, which means that they are executed before almost anything else. Most functions have only one operand, but some have more. The square-root function, sqr, for example, has only one operand; screen, on the other hand, has three. The operands of the function are always evaluated first and the values put on the operand stack, since they are enclosed in parentheses. When the function call comes around to being executed, it takes as many operands as it is allowed from the operand stack, and a result is returned.

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```
SQR(A+B)*C
```

The sqr goes on the operator stack as a unary operator—an operator that has only one operand. The left parenthesis goes on next, and then A+B is evaluated according to the procedures outlined in the preceding paragraphs. At this point we have:

Operands	Operators
[A+B]	SQR

Now, when the parser comes to the multiplication sign, it realizes that the operator stack already has an operator of higher precedence—the square-root function; this higher-priority operator must be executed first. The square-root operator is carried out on its unary operand, and the result, the square root of A+B, is placed on the operand stack. Now, with the operator stack empty, the parser pushes the multiplication sign, and the rest follows as in our first example.

So far we have been dealing only with arithmetic operators. In *if* statements there is a need for relational and logical operators as well.

Relational operators evaluate the truth or falseness of an expression and return a logical value of −1 for true and 0 for false. Logical operators, such as *and* and *or*, are used to evaluate the relationship between two or more relations; they too return values of true or false. For example, in the statement

```
IF A+B<C AND C>10 GOTO 100
```

the greater-than and less-than signs are relational operators, while the *and* is a logical operator. Page 3-26 of the Basic manual offers a table of logical operators.

Relational operators evaluate the truth or falseness of an expression. . . .

The arithmetic operators all have higher precedence than any of the relationals, and logical operators have the lowest precedence. This arrangement minimizes the use of parentheses. Take another look at that *if* statement:

```
IF A+B<C AND C>10 GOTO 100
```

Intuition tells us that what we want to do is perform the arithmetic first, then make the comparisons. Then and only then can we decide if both conditions are met and take the appropriate action.

What about errors? It is the parser's job to detect most of the errors in Basic statements. Some are very easy to find. A mistake like putting two operators in a row, as in A+−B, is found as soon as the minus sign is scanned. Others must wait until most of the statement analysis is finished. For example, the following statement is missing a right parenthesis:

```
A*(B+C
```

The parser notices the fault only when it comes to the end of the line and finds that there's a parenthesis on top of the operator stack.

Finally, what are the practical implications of all this information? Can you use any of it to make your programs run more efficiently?

Indeed. Knowing now how much work goes into the parsing of Basic expressions, you can move expressions out of loops if they don't need to be there. For example, if you need *sqr(A+B)* in a loop, and if A and B are not recomputed within the loop, you can assign the value of *sqr(A+B)* to a variable before the beginning of the loop. That will lighten the interpreter's load and make your program run marginally faster. ▲

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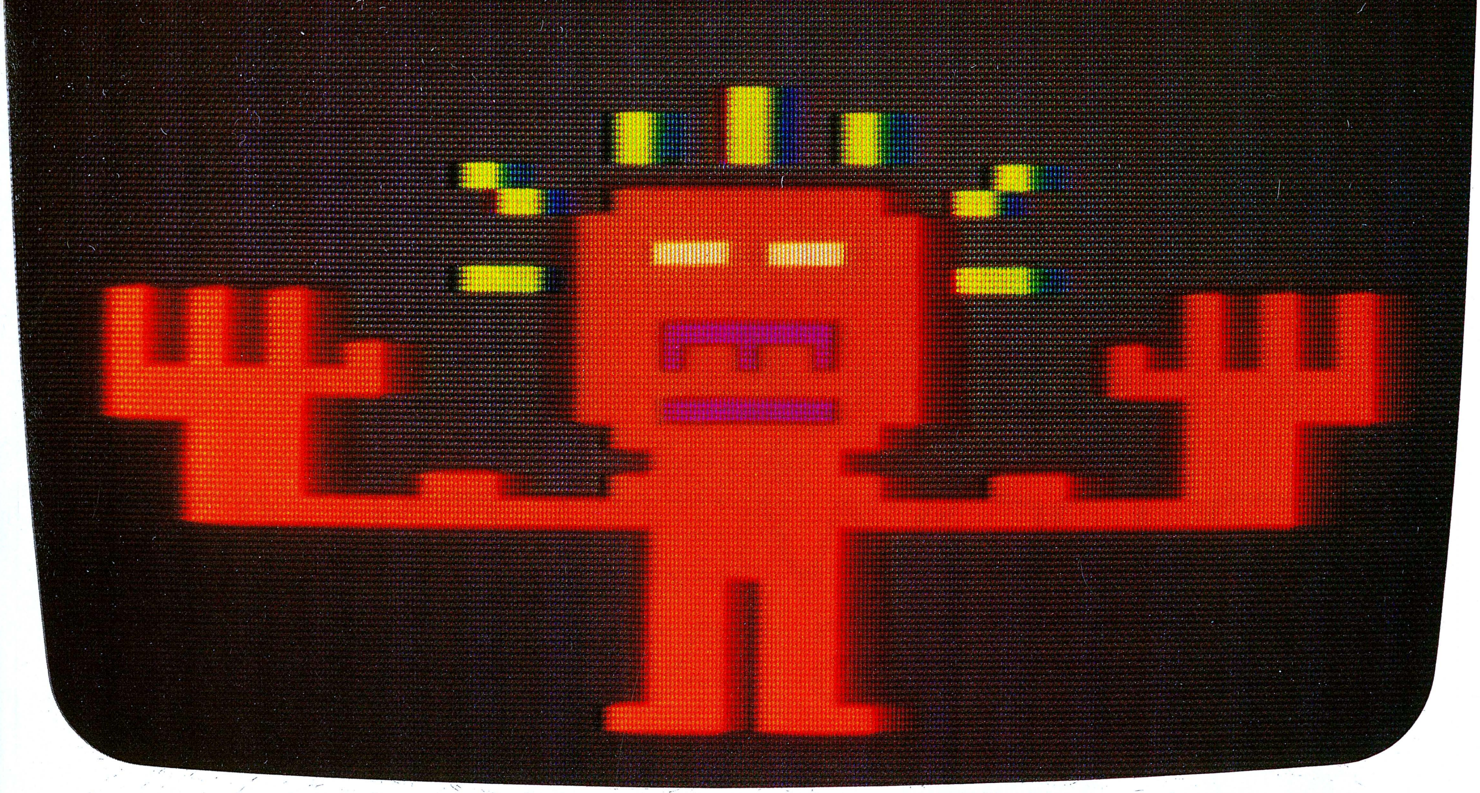

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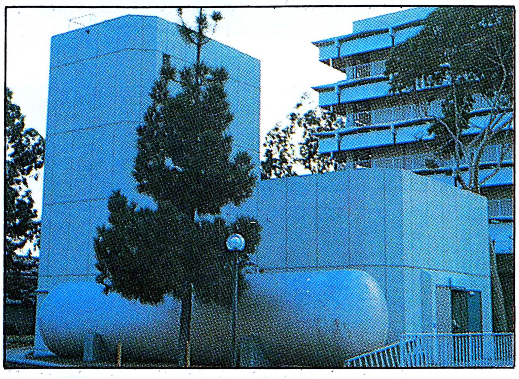
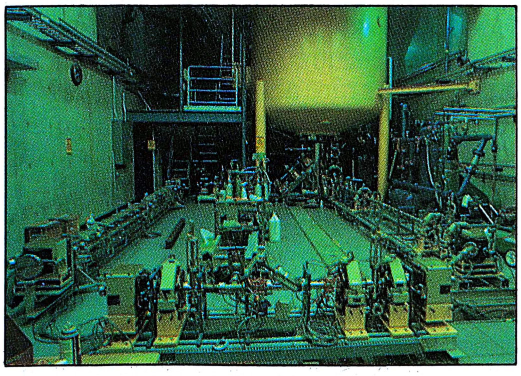
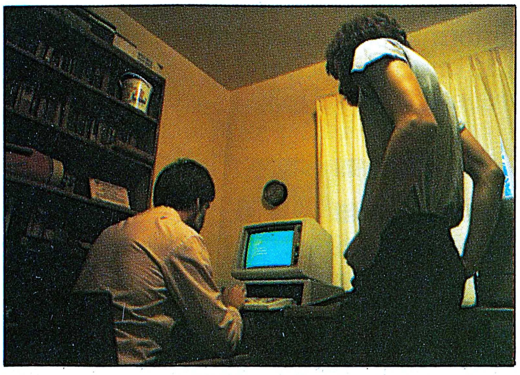






Top left: The free-electron laser being built at UCSB takes up the entire building shown in the foreground. Middle: Inside the building, the U-shaped mechanism takes shape. Bottom: Logging on to the Cray at Los Alamos from Colson's home, Colson and programmer Joe Blau work on a problem.

by Michael Ferris

Many people have a deep conviction that the universe is orderly and the principles on which it's ordered can be known by man. Some even maintain that the universe is written in code and that it's the job of the scientist to crack that code.

Philosopher Francis Bacon, an early proponent of this thinking, believed there were two revelations, the first given by scripture and tradition, the second by the universe.

According to physicist Heinz R. Pagels, when the history of this century is written, the significance of political events will pale in comparison to that of technological events.

"Instead," writes Pagels in *The Cosmic Code,* "the main event will be the first human contact with the invisible quantum world and the subsequent biological and computer revolutions."

No single set of ideas has ever had greater impact than the quantum theories relating to the immutable laws of the universe, he states. The decoding of the atom and our grasp of its laws sparked a revolution in physics, beginning with Einstein's first papers on relativity and the photoelectric effect published in 1905.

It is our mastery of these concepts that has given rise to industries based around such technological advancements as the transistor, the microchip, cryogenic technology, and the laser.

Laser technology and computer technology both grew out of solid-state physics and developed along parallel lines. In the future, lasers may even be used to etch very small computer chips.

Right now, the IBM Personal Computer is helping develop a new kind of laser. More versatile than conventional lasers, the free-electron laser promises to be as important as the thousands of lasers now in use.

For the past nine years, research professor and consulting physicist Bill Colson has been exploring the theory underlying the free-electron laser. Recently, an IBM Personal Computer, equipped with the Qunix operating system, has been assisting him at home.

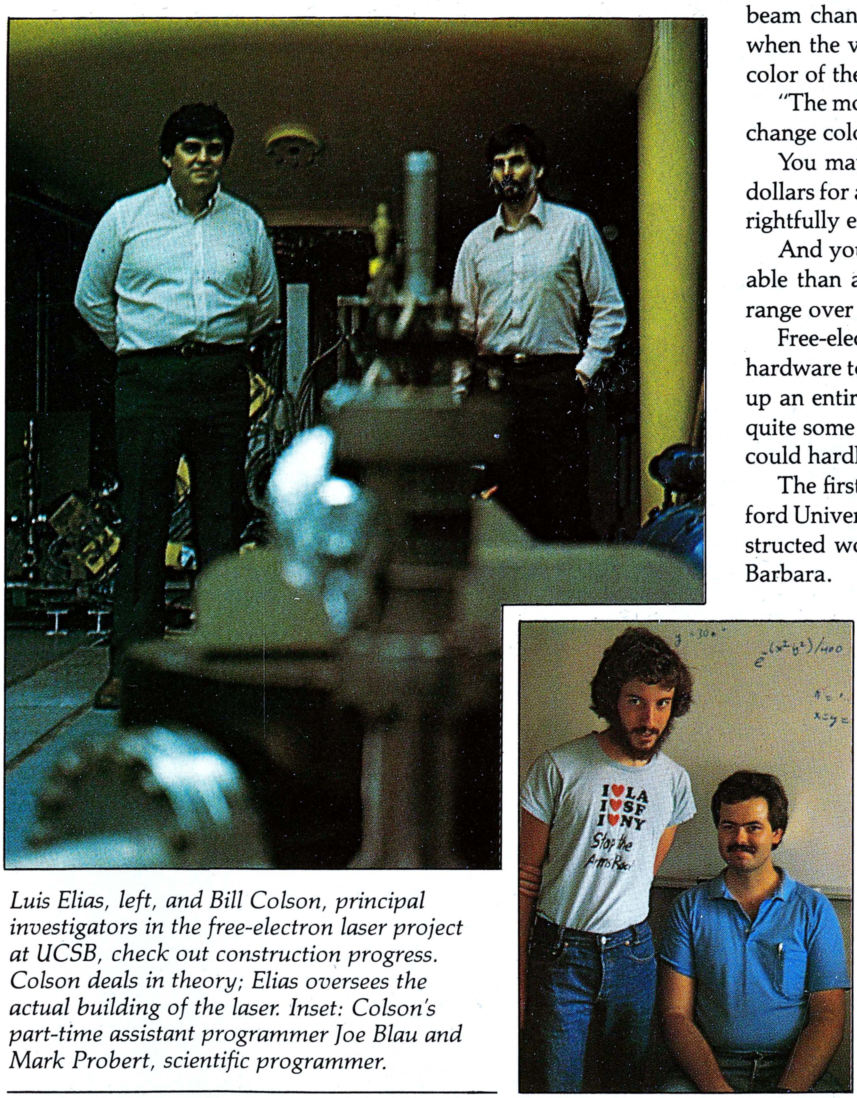
Actually, Colson's pc keeps busy in a number of ways. It does number crunching, acts as a terminal from which to communicate with

Colson gets one band of color from a prism, illustrating the limitation of most conventional lasers.

other computers, and aids Colson in his consulting work for Berkeley Scholars, an independent research group.

Since it has proved itself "a smart little central computer," Colson has ordered a pc of his own for his office at the University of California at Santa Barbara. Until it arrives, his home pc is helping him advance the theory of free-electron lasers.

Like computers, lasers are generally seen as miracle workers. Only those people who are on more intimate terms with them realize that there are almost as many kinds of lasers as there are applications for them.



Luis Elias, left, and Bill Colson, principal investigators in the free-electron laser project at UCSB, check out construction progress. Colson deals in theory; Elias oversees the actual building of the laser. Inset: Colson's part-time assistant programmer Joe Blau and Mark Probert, scientific programmer.

A Primer on Lasers. Very simply, here's how a conventional laser works. The atoms in a solid or gas material are pumped into an excited state by sometimes just a spark. The photons released from these atoms are bounced around millions of times between mirrors until, just by chance, some of them begin stepping coherently in the same direction.

This encourages the other photons to emit in step until columns of them, marching in cadence like good soldiers, make their way down the business end of a laser. This results in a powerful, coherent beam of light.

Conventional lasers can be created from a variety of materials, including synthetic rubies and helium-neon gas mixtures. It's possible to build a table-top laser for medical use that cuts like a scalpel of light, as well as a satellite model for communications that transmits messages across space and a hand-held laser that gently cleans valuable artwork. One of the most significant laser applications is in the field of atomic spectroscopy, the study of material and how radiation affects it.

Most lasers are monochromatic specialists, giving coherent light only at one wavelength. Different applications require different colors of light. Some lasers are slightly tuneable, meaning that they can change color, but only within about 1 percent of their wavelength.

Free-electron lasers make use of a highly relativistic beam of electrons moving at 99.99 percent of the speed of light. This beam passes through a periodic magnetic field surrounded by mirrors. The electrons "wiggle" as they pass through this field, radiating as they would in an excited atom. Out of this wiggling comes the coherence.

Initially, each electron is going so fast its energy corresponds to fifty million volts per electron. Changing the energy, or speed, of the beam changes the way the electrons wiggle. In a free-electron laser, when the voltage is changed, for example, to forty million volts, the color of the beam is changed.

"The most important feature of free-electron lasers is their ability to change color to a much larger extent," explains Colson.

You may be willing to pay anywhere from fifty to fifty thousand dollars for a dedicated laser, but for the $2 to $10 million it costs, you'd rightfully expect more from a free-electron laser.

And you'd get more. Free-electron lasers are incredibly more tuneable than any conventional laser. The free-electron laser's beam can range over 1,000 percent of its initial wavelength.

Free-electron lasers are still experimental units in their infancy. The hardware to support such a laser is a mammoth construction that takes up an entire building. You won't be able to purchase such a laser for quite some time, even if you could get it in your garage. Besides, you could hardly afford one.

The first free-electron laser experiment was begun in 1974 at Stanford University in Palo Alto. Since then, more than ten have been constructed worldwide. One is scheduled to start up soon at UC Santa Barbara.

The free-electron laser research at UCSB, sponsored by grants, is the work of about a dozen people. The F.E.L. group is associated with the Quantum Institute and the physics department, but it's not part of them.

Colson and Luis Elias, both adjunct professors of physics, are designated Principal Investigators and run the show. Both are involved primarily with research and teach occasionally. Two assistant research physicists, an electrical engineer, students, and various technicians including full- and part-time programmers round out the group.

Part of Colson's job as P.I. is to designate areas of research. "I have a freedom under the grants to find out what's important to work on," he says. "I suggest and generally they go along."

As leader of the theory group, he exercises a high level of scientific discretion. "My job is to blend what hasn't been done with what's important," he says. Concentrating on an area that not too many people are working in contributes to its importance.

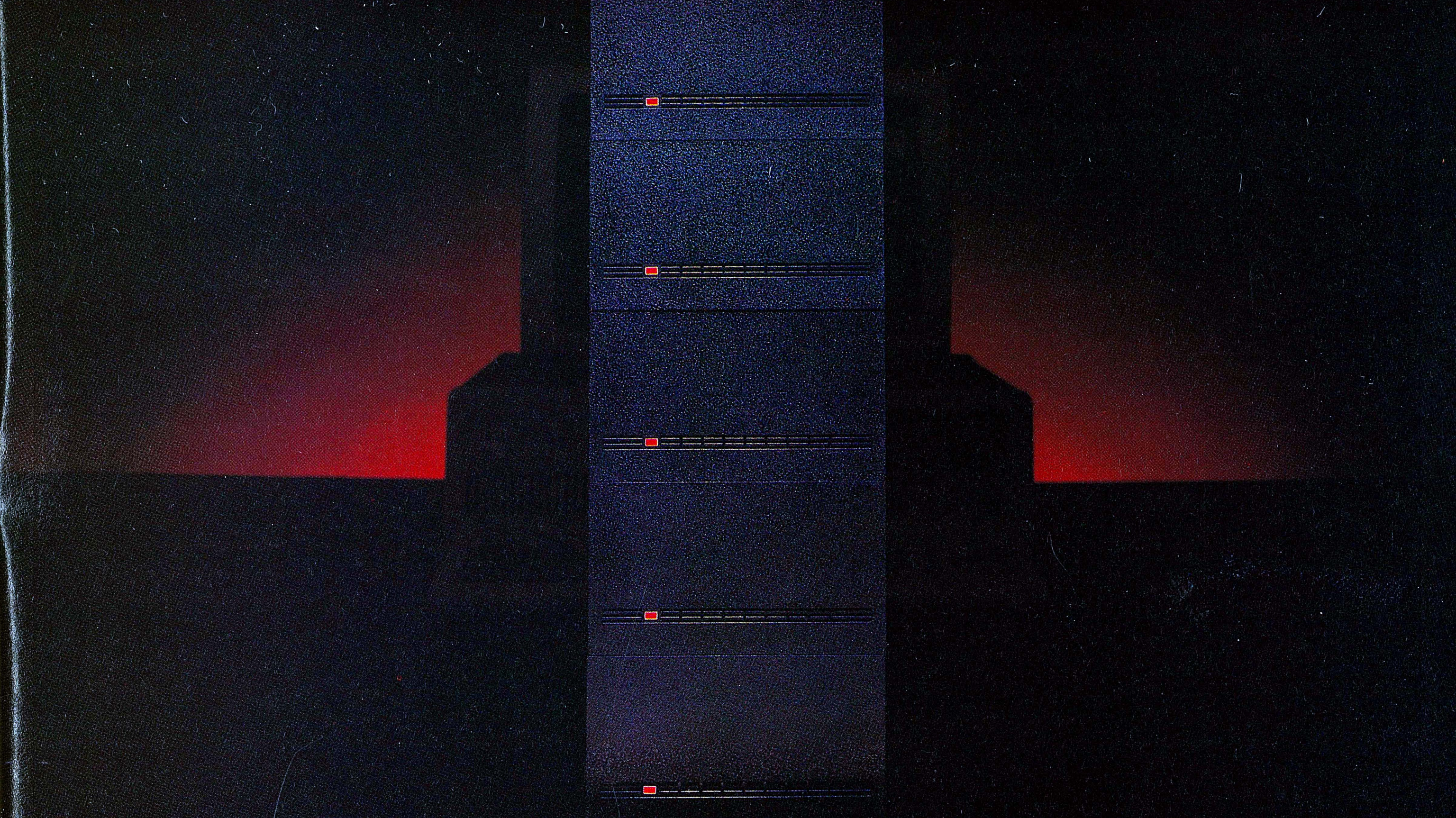
For the Sake of Science. Colson's free-electron laser work is funded by both the Air Force Office of Scientific Research and the Office of Naval Research, but it's pure science research, not military research.

The findings are published as public domain papers in various books and scientific periodicals such as the *Journal of Quantum Electronics* and *Physical Review Letters.* Each year, five or six of his papers are published, and Colson gives several talks to various scientific peer groups.

None of his findings is "classified" and some of what he studies and reports on is even translated into Russian and published in the U.S.S.R.

"The Air Force and Navy both feel part of a good defense is to have a lot of smart people working over here," explains Colson. "They both fund a significant amount of the pure science research going on in this country."

While engineers grapple with the concrete realities of free-electron



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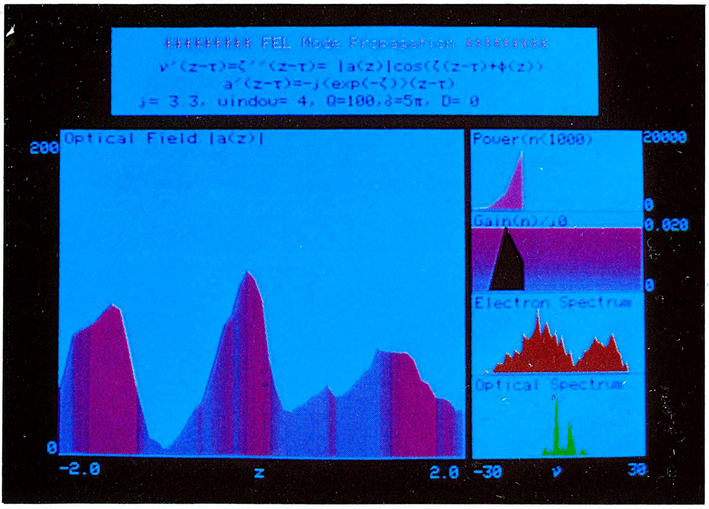

In Colson's two-minute movies of simulated lasers, factors of a laser's theoretical performance are separately graphed.

laser research, physicists and theory specialists like Colson work in the abstract. Colson models theoretical lasers on various computers, from the "fastest computer in the world" to the pc.

Calculus is the workhorse of the research. Colson's task is to write mathematical programs that simulate actual free-electron lasers.

Often, after finishing a paper defining one theoretical aspect of a laser concept, he finds that some element has changed and the programs must change also. He's constantly redoing his calculations to maintain coherence.

Out of more than two hundred programs, twenty are the most important. If any of those core programs were suddenly erased, "it would take a few weeks to build back up," he says. That's why he saves pieces of programming from as far back as five years.

"I'll start out writing a new program for evaluating a new effect," he explains, "and end up borrowing parts of a previous body of work. Most of my work is rewriting."

Some of Colson's mathematical guesswork is shown graphically on plotted paper, some is shown on computer monitors. Movies are shot from the computer screen, one frame at a time like animated cartoons, showing simulated free-electron laser concepts in action. This allows other scientists all over the world to see how a certain adjustment or type of experiment will affect a real free-electron laser.

Until now, the movies have been made by setting up a film camera in front of a Chromatics computer running off a Vax mini. A special "black box" was built that allows a beep from a program to activate the camera, exposing one frame and then moving on to the next.

Turning diagnostic computer plots into one- and two-minute movies is just another exotic development in an already exotic field.

Enter the pc. Now, instead of having the Vax doing all the work, Colson is gradually bringing the pc into the picture as program manager, to run the preparation programs he has written for the Chromatics movies.

Equipped with extra graphics expansion cards and a special monitor, the pc could be souped up to replace the Chromatics. Resolution of 1000 by 780 and a palette of sixteen colors could be achieved. Two such pcs could be purchased for the price of one Chromatics standalone computer.

Working at the office in his home, ten minutes off campus, Colson is able to connect his pc to the Vax minis to exchange programs in either C or Fortran, via modem. He can also contact the Cray mainframe at Los Alamos National Laboratory in New Mexico, another center of free-electron laser research. The Cray is the fastest computer in the world, according to Colson, a thousand times faster than the pc.

Even though it's the fastest computer in the world, it's a shame to waste the Cray's time. At Los Alamos, IBM Personal Computers are used for certain tasks, says Colson, thereby saving the Cray for hard calculating. That's exactly what Colson himself does: He compiles data on the pc, runs it on the Cray in a batch job, and gets back numbers.

"Hopefully, the Los Alamos people will be able to develop standardized software for the pc," says Colson. "It would make our work that much easier."

Logging on to the Cray from his pc at home, Colson must abide by its particular security protocol. "You have thirty seconds to log on or it will disconnect," he explains. "Without the manual on your lap, you could easily screw up.

"If it hangs up on you five times in a row, you're blacklisted and have to call important people to get back on."

In addition, time on the Cray is expensive. "You could almost buy a pc with what it costs every hour," he jokes.

On a typical day at the university, Colson might talk to the Unix, Qunix, and VMS operating systems, speaking either Fortran, C, or Basic. Each system has a different editor and each language has its own set of commands.

"The same idea can be explored in Fortran or C," explains Colson, "and each language has attributes that make it unique." One may be more suitable than the other for working on a particular theoretical calculation.

At the same time, the various graphics devices call separate software drivers. For example, C must be used to address the Chromatics terminal and Fortran must be used to drive a particular plotter.

UCSB has two time-sharing Vax minis on campus that speak C, Basic, and Fortran, running under the Unix operating system. In his office, Colson currently accesses them through the Chromatics terminal. Soon it will be a pc.

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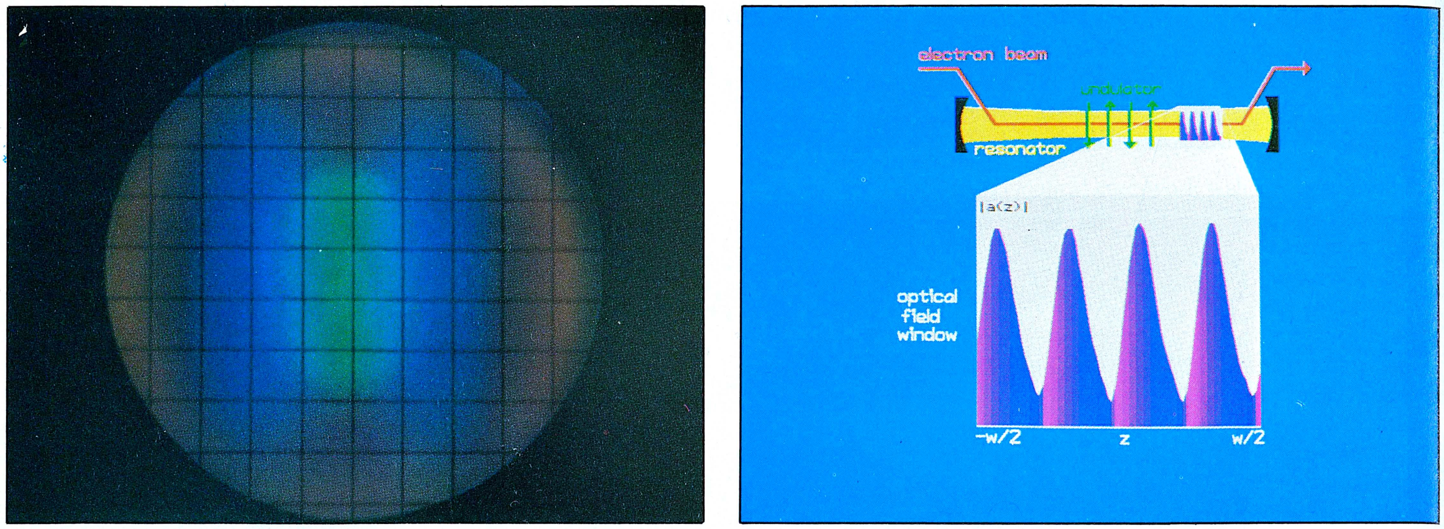

Left: The beam of an Italian free-electron laser experiment shows the range of available intensities. Colson regularly trades information and software with the Italian scientists. Right: This cutaway section shows the electrons of a free-electron laser in coherence.

The new pc will be the heart of a multiuser, multitasking configuration. Two dumb terminals, a printer, and a graphics workstation, all located in nearby offices, will connect to Colson's office pc. Modem lines will connect this pc to the two Vaxes, the pc at home, and the outside computer world.

"For our type of research, the 8087 math chip makes the pc one-fifth as powerful as a Vax," Colson explains. "This means it is the equivalent of the Vax with five people using it at the same time. Typically, we have to put up with twenty people on the Vax."

A problem that might take four hours to run on a Vax may take a day to solve on the pc, but with multitasking the pc won't be tied up calculating; it will be available for word processing and other work.

So Many Computers, So Little Time. College research scientists may operate in a rarefied atmosphere of exotic ideas and concepts, but they have the same computer problems as the rest of us. And everything from mainframes to micros is called into action in this environment.

"One of the hazards of working with too many computers," warns Colson, "is they all have different rules." A mix of computers is a mixed blessing. Multitasking operating systems like Unix and Qunix and a portable language like C are helping to standardize Colson's growing computer jungle.

The Unix operating system, created by Bell Labs, can serve several users at the same time. "It's simple, flexible, and powerful," says Colson. So what if the system documentation is six inches thick.

The built-in editor on the Unix system is called Vi. It has extensive single-keystroke commands and doesn't use function keys.

Qunix for the pc, by Quantum Systems Software, is a micro version of Unix, one of several currently in use, like Xenix and Venix. The Qunix text editor is called Ed, and it's a kissing cousin to Vi. Ed was originally implemented to use function keys, but its command structure is flexible. A package of commands that make it work like Vi will soon be available, closing the gap between the two operating systems.

A link between Unix and its offspring is their common ability to run the same language, C, with no program changes. C's biggest advantage is its style. Like Pascal, it's a structured language. "It's a low-level language, almost like assembly, but not as bad," Colson says.

"With C," he elaborates, "logic is easier to understand from the screen. For example, program lines don't mean a thing; you indicate a statement ending with a semicolon, and loops are separated by curly brackets."

C, the Qunix operating system, and the pc are three new elements that work together to facilitate Colson's dealings with the world of computerized physics. Getting the fine details worked out between them isn't always easy, but it's more than worth it in the end. These powerful new tools allow Colson to concentrate on the work that's really important to him.

For Colson, the challenge of free-electron laser research is "playing with principles you know other researchers haven't played with before."

For what it's worth, he says it's fun, too, but who would believe that when it comes from the high tower of a university physics building? ▲

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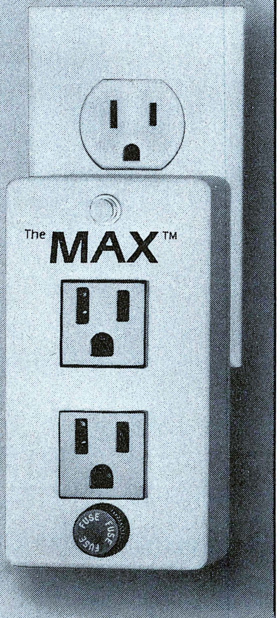

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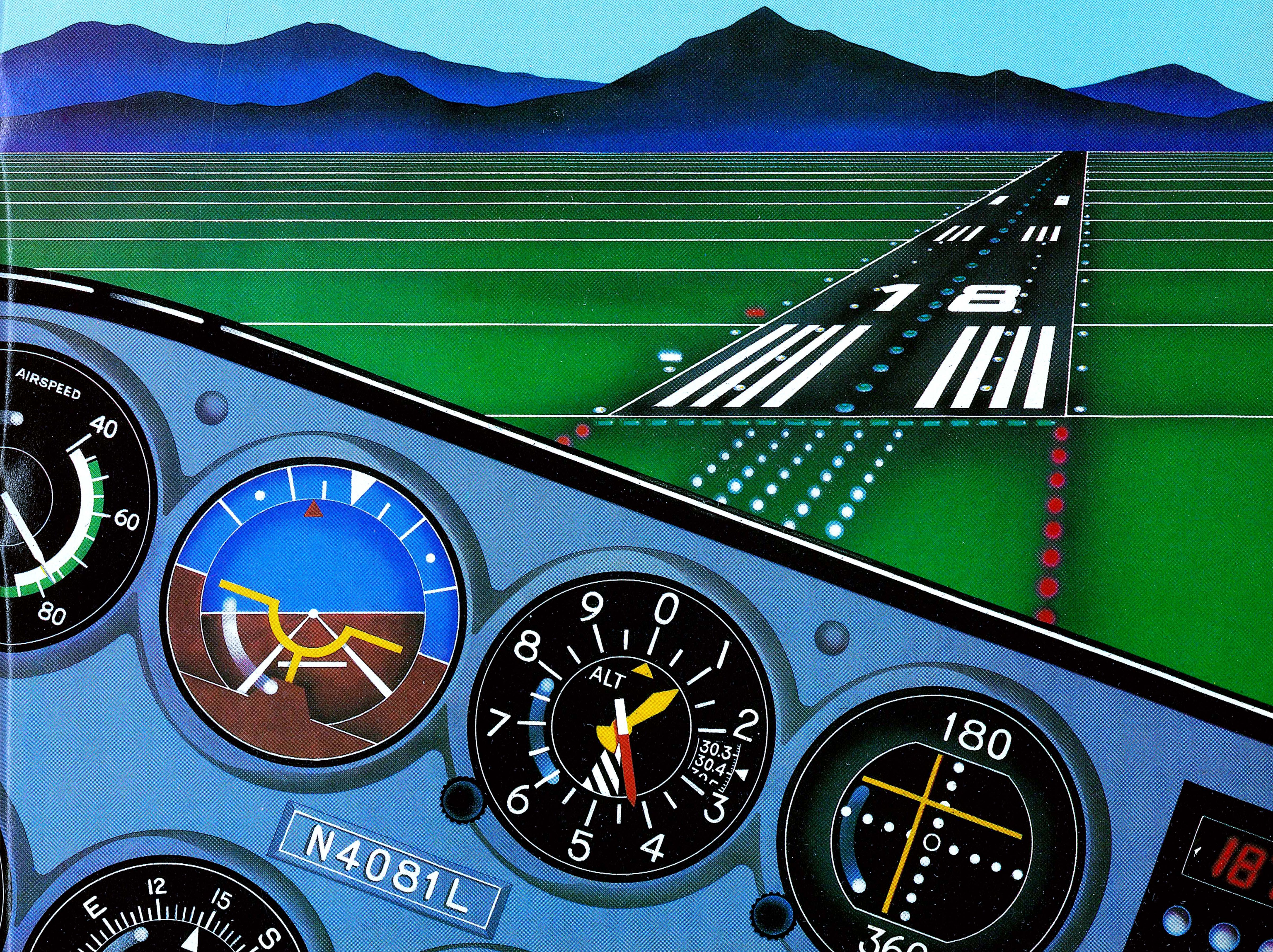

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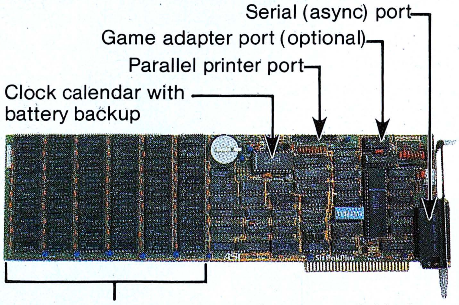
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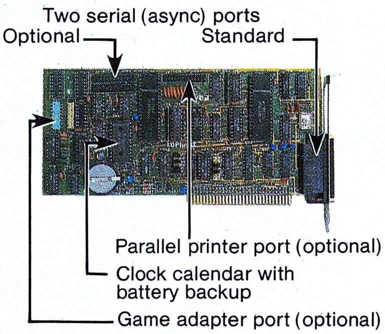
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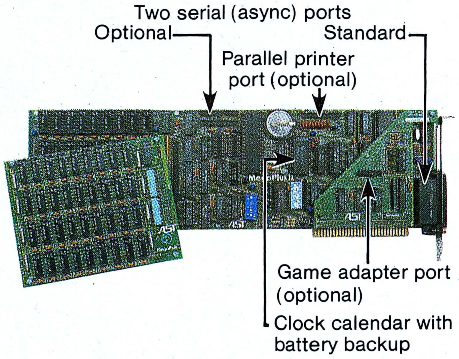
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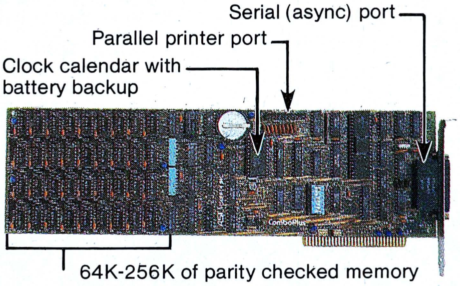
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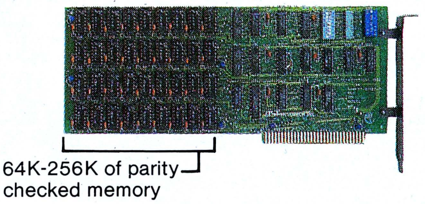
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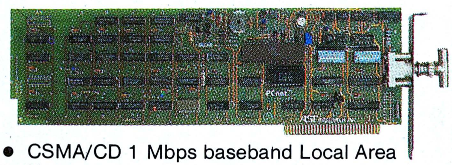

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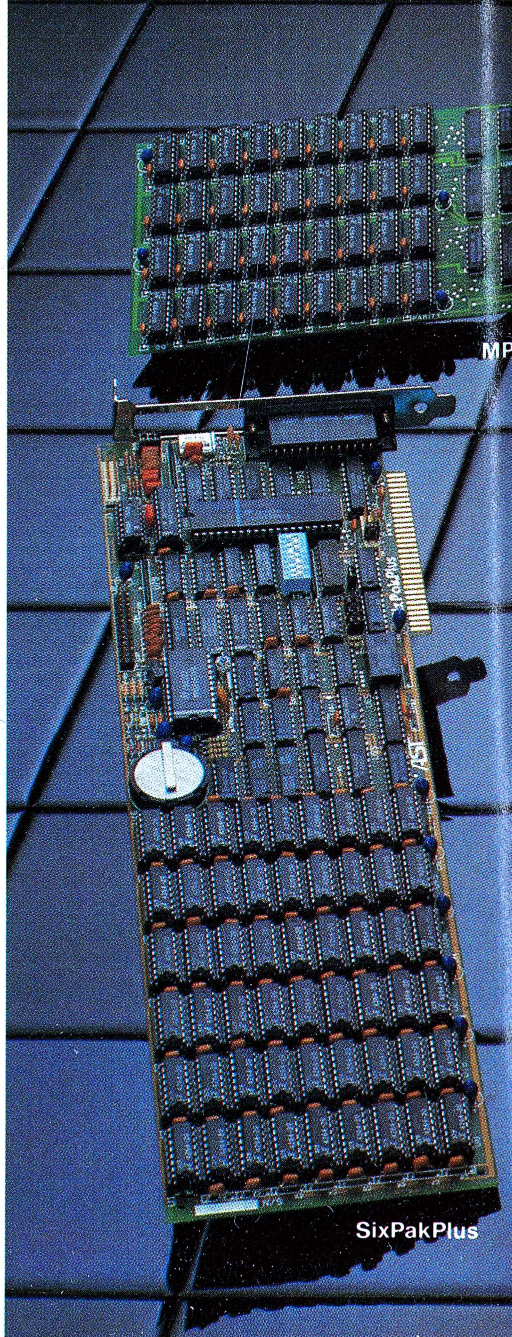
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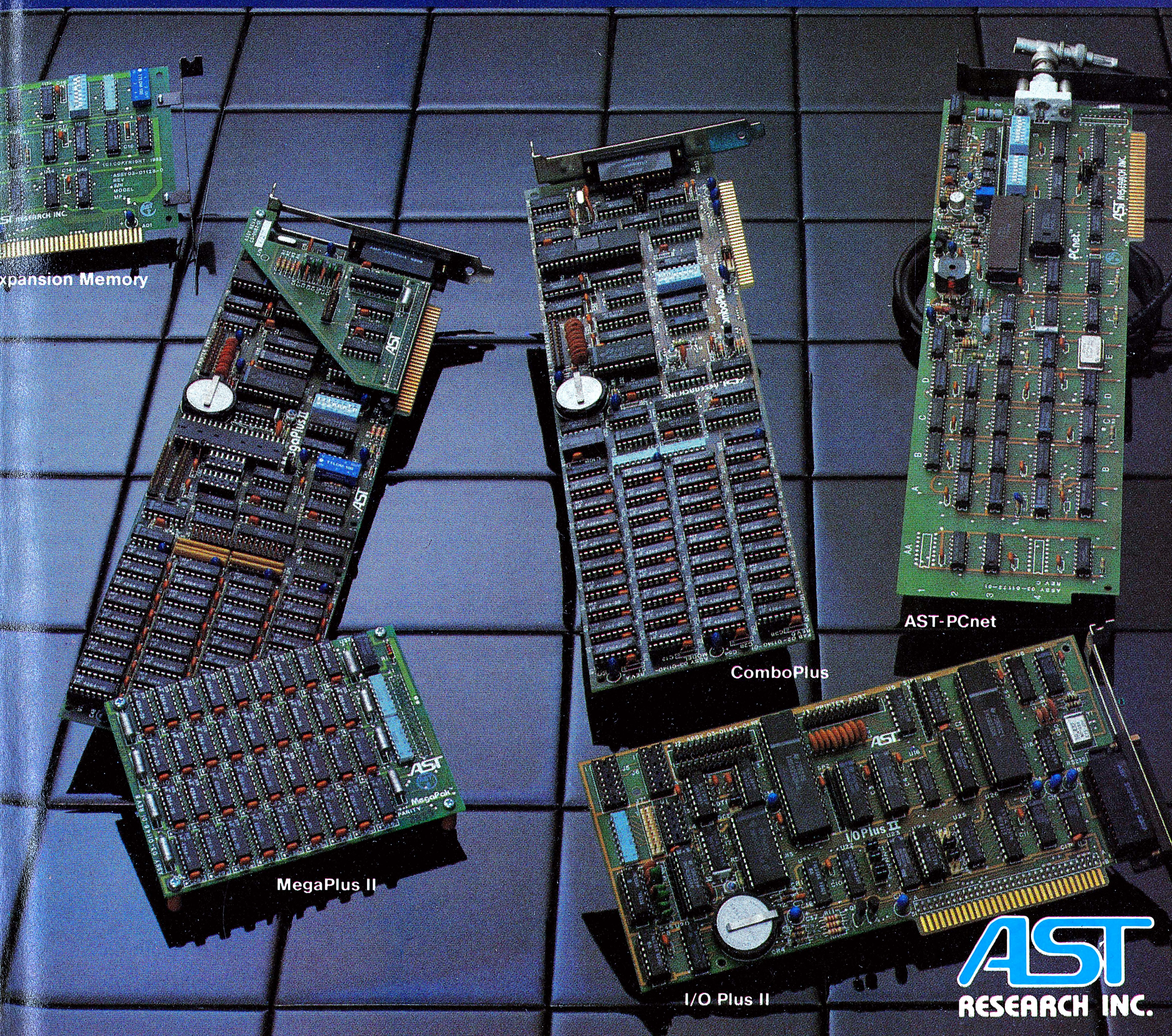

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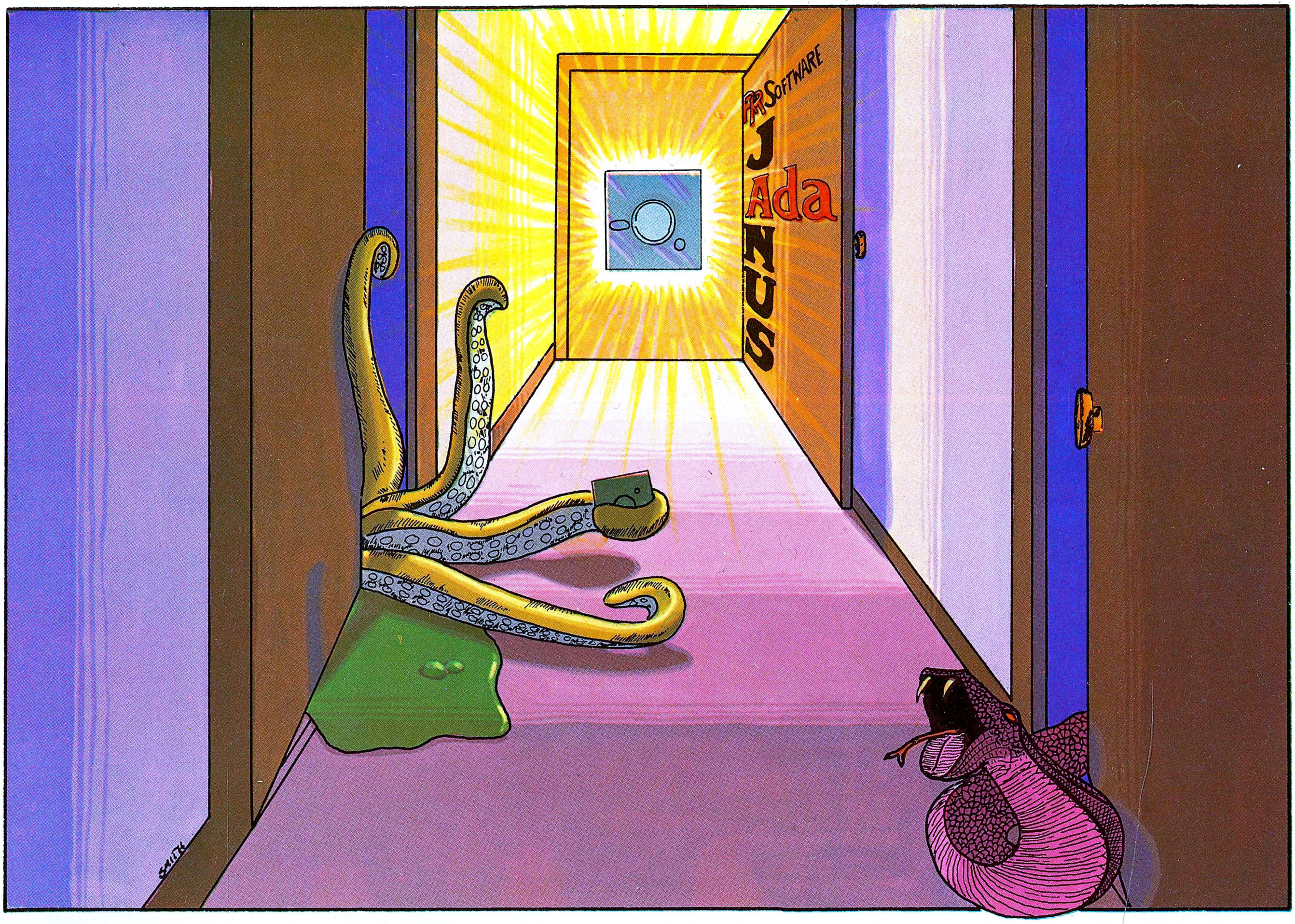

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BSCBAS

Structured Programming in BASIC

by Mark Gardner

Basic continues to be popular, in spite of its age and in spite of the increasing popularity of more modern languages. It seems safe to say that, whatever the merits of other languages, Basic will be useful (and in use) for some time to come. It may not be ideal for all applications, but it fits well for many and it often relieves the programmer of a good deal of tedium.

But it does have problems, of course, particularly in the areas of structure, commentability, and integrity. This article presents a program that will alleviate some of those Basic shortcomings.

Structure, in this context, means not only what professional programmers signify by that word, but also the commonsense connotations—the ability to put a program down on paper with understandable subdivisions and separations; to use and move subroutines routinely; to insert and delete sections without pain; and to group common functions into single program modules. Programming seriously in Basic can be quite a chore, since the lack of structure and the requirement that lines be numbered present problems for the programmer that have very little to do with getting instructions right.

Comments must support the structure and inform the programmer. Even the simplest Basic program can be virtually incomprehensible without sufficient comments. But programs run slower when an interpreter has to process many *rem* statements, and heavily commented programs take up a lot of memory space.

Finally, the ease with which a Basic program can be patched and saved is in itself a liability, because it can lead to the making of undocumented changes—changes that can inconvenience or even infuriate other program users.

Of course, with a great deal of care and patience, you can cope successfully with Basic's shortcomings. But should you?

The program presented in this article, itself written in Basic, processes structured, heavily commented, unnumbered Basic source files into .bas files ready to run. The program, entitled BSCBas, has been used successfully on a number of ambitious projects and has brought about significant savings of time and enhancements of control and documentation.

WHAT BSCBas DOES

BSCBas will work with standard ASCII source files, produced by a text editor (*WordStar* in nondocument mode, Edlin, *Personal Editor*, whatever). A standard extension of .bsc is applied to the source file names. The source files contain valid Basic program statements without line numbers. Comments are preceded by semicolons and do not need the *rem* keyword. For a very simple example of a BSCBas source file, see figure 1.

When BSCBas is used to convert this file to .bas format, lines are numbered and comments are either preserved or not—at the discretion of the user. The two possible output forms for figure 1 are shown in figure 2.

Of course, the mere ability to remove comments and number lines is not very exciting. What's really helpful about BSCBas is its ability to deal with named entry points for subroutines and control jumps and to handle other needed references to line numbers. See figure 3 for a more complex source file and the (uncommented) executable Basic program produced from it.

Notice the significant reduction in size achieved by removing the comment lines from this source file. Also notice how uncomfortable you would be trying to understand the intent of this rather simple program, with its fluke catch-all routine, if you didn't have comments in a source file.

BSCBas determines the appropriate replacements for the reference names. The reference numbers are of the line following the name definition; this speeds up execution if comments are left in, and it also allows restore instructions to refer correctly to data lines.

```
; EXAMPLE1.BSC   2-18-83   MRG
; Program to demonstrate the simplest level of BSCBAS use
DIM X(20),Y(20)
; Initialize the arrays
FOR I=0 TO 20
X(I)=I
Y(I)=I+2
NEXT I
; Calculate and print output
FOR I=0 TO 20
PRINT I,X(I)*Y(0),X(I)-Y(I)
NEXT I
END
```

Figure 1. An example of a simple source file

```
10 REM ; EXAMPLE1.BSC   2-18-83   MRG
20 REM ; Program to demonstrate the simplest level of
    BSCBAS use
30 DIM X(20),Y(20)
40 REM ; Initialize the arrays
50 FOR I=0 TO 20
60 X(I)=I
70 Y(I)=I+2
80 NEXT I
90 REM ; Calculate and print output
100 FOR I=0 TO 20
110 PRINT I,X(I)*Y(I),X(I)-Y(I)
120 NEXT I
130 END
```

```
10 DIM X(20),Y(20)
20 FOR I=0 TO 20
30 X(I)=I
40 Y(I)=I+2
50 NEXT I
60 FOR I=0 TO 20
70 PRINT I,X(I)*Y(I),X(I)-Y(I)
80 NEXT I
90 END
```

Figure 2.

```
; EXAMPLE2.BSC   2-18-83   MRG
; Program to demonstrate some name handling abilities of BSCBAS
 DIM STRINGINDEX(50)
 DIM STRINGELEMENT(20)
FRSTDT:      DATA TO USE FIRST
DATA 1,2,3,4,5,6,7
SECDDT:      DATA TO USE SECOND
DATA A,B,C,D,E
GO TO MAINPG

;*ASMPRN — subroutine to assemble and print an ascii
   string from
;   selected array elements
ASMPRN:      Assemble and print array elements
; Initialize the print string
  PRINTSTRING$=“”
; For each chosen element, insert tab and ascii equivalent into
;   print string
 FOR I=0 TO 4
     PRINTSTRING$=PRINTSTRING$+CHR$(9)
        +STR$(STRINGELEMENT(I))
  NEXT I
; Print the final string
  PRINT PRINTSTRING$

;*CTCHAL— subroutine to contain other examples of BSCBAS
;   references.
CTCHAL:      CATCH ALL SUBROUTINE FOR
REMAINING EXAMPLES
ON ERROR GO TO CTCHAL
IF ERL < > CTCHAL THEN GO TO MAINPG
ON Y GO TO CTCHAL,ASMPRN,MAINPG
IF Z THEN GOTO MAINPG
IF X THEN GO TO ASMPRN
RESUME ASMPRN
RESTORE FRSTDT
RESTORE SECDDT
RETURN

;*MAINPG — main program, does little in this example
MAINPG:      Main Program
; Initialize the string element
FOR I=0 TO 20
     STRINGELEMENT(I)=I
NEXT I
; Pick some indexes
MORELM:      more elements, entry point to solicit users' element
;      numbers
FOR I=0 TO 4
RETRYX:      Retry getting the input, entry point if entry is too big
     INPUT “Please type number from 0 to 20 ”; J
     IF J>20 OR J<0 THEN GO TO RETRYX
     STRINGINDEX(I)=J
NEXT I
; Now print the selected string elements
GOSUB ASMPRN
; And go and ask for more from the user
GO TO MORELM
; That's all for this example
END
```

```
10 DIM STRINGINDEX(5)
20 DIM STRINGELEMENT(20)
30 DATA 1,2,3,4,5,6,7
40 DATA A,B,C,D,E
50 GOTO 200
60      PRINTSTRING$=“”
70      FOR I=0 TO 4
80         PRINTSTRING$=PRINTSTRING$+CHR$(9)
              +STR$(STRINGELEMENT(I))
90      NEXT I
100      PRINT PRINTSTRING$
110 ON ERROR GOTO 110
120 IF ERL < > 110 THEN GOTO 200
130 ON Y GOTO 110, 60, 200
140 IF Z THEN GOTO 200
150 IF X THEN GOTO   60
160 RESUME      60
170 RESTORE      30
180 RESTORE      40
190 RETURN
200 FOR I=0 TO 20
210      STRINGELEMENT(I)=I
220 NEXT I
230 FOR I=0 TO 4
240      INPUT “Please type number from 0 to 20 ”; J
250      IF J>20 OR J<0 THEN GOTO 240
260      STRINGINDEX(I)=J
270 NEXT I
280 GOSUB      60
290 GOTO      230
300 END
```

Figure 3.

USING BSCBas

The BSCBas program itself is easy to use, either under interpreted IBM Basic or in compiled form. The program asks the user what file to process (you enter that information without the .bsc extension) and whether comments and names should be stripped. Names in the source file may be one to six characters in length; the first character must be alphabetic. In name definition lines, the name must start in the first column and end with a colon. Characters following the colon on the line are ignored, so you have an opportunity to explain what the names mean.

Names can be used in almost any way that a line number would be used—after *goto*, *go to*, *gosub*, *resume*, and *restore* keywords. Not supported are *list*, *run*, and the other direct-mode commands such as *renum*. *Then* is also not supported; you have to use it as *then goto* or *then go to*. This is because BSCBas can't tell whether a name or a statement follows the then keyword. References to names are permitted with *erl* (error line), provided that both the *erl* and the name are bracketed by spaces, as in

```
IF ERL <= READIN THEN GO TO WHTSIT
```

Strings of names are allowed, which means you can use the computed *goto*. The constraint here is that the names must be separated by commas, but with no intervening spaces. For example:

```
ON X(I) GOSUB PROCS,PRNT,LEVPRG
```

Names must be on the end of a line and may not appear in "interior" statements or as the reference following a *then goto* in an *if* statement with an *else* on the same line. Notice the failure of the program to find replacement numbers for Name4 in the source file shown in figure 4. Immediately following the incorrect name reference in the source program is the normal way to get around the problem.

HOW BSCBas DOES ITS WORK

Figure 5 shows a .bsc format version of BSCBas, which you should follow while reading the following descriptions.

After asking the user for the file to process (given with no extension), the program opens the input file and creates a work (.wrk) file to use in the first pass. The file is read through once, so that lines may be numbered. At the same time, name definitions are stored, together with a line number for the reference replacements to be made in the second pass. The stored number is for the line following the name definition, so that references to *erl* and *restore* can be correct.

Names are detected by the presence of a colon in columns 2 through 7, which causes control flow to pass to the section named Namdef. The storage array for names is Names(100,7), and the names (up to 100) are stored in slots 1 through 6 of the array's second dimension, with each character of the name converted to a number by means of the *asc* and *mid$* functions. The element just after the last character is set to 255 as a flag for the end of the name. The corresponding line numbers are stored similarly in the Numbers array.

If a line has a name or if it starts with a semicolon, the line is a comment line and is passed into the program section starting with Remlin. If the strip flag is set, the line is merely ignored. If it isn't, the current line number, plus the *rem* keyword, are added to the front of the line, and the line is written to the work file. Other lines (lines that are neither name lines nor comment lines) are passed to the code at Pnline, where the current line number is attached to the front, and the line is written to the work file.

Termination of this line-by-line process is not elegant but it is effective: An end-of-file error when the input file is read carries execution to Endfil. BSCBas checks the error type to verify that it has, in fact, reached the end of the source file, and then it closes the files and begins the second pass.

FILLING IN THE NAMES

For the second pass, the work file is opened as input and a .bas file is opened for output. This time through, each line (except for any comment lines, which still contain semicolons) is checked to see if there is a name at the end of the line. The character group last on the line is a possible name, and the character group just before is a possible command. If the possible command is *goto*, *gosub*, *resume*, *restore*, or *to* preceded by *go*, then the possible name is processed by the code following the entry Chknam.

The possible name is checked to see if it is a multiple name. If it is, the names are sorted into the Tryname$ array. If not, the single possible name becomes the first element in the Tryname$ array. The number of names is set to 1, at least, or to the number of names within the multiple name.

```
NAME1:
NAME2:
NAME3:
ON X GO TO NAME1,NAME2,NAME3

GOSUB NAME4:    GO TO NAME2
GOSUB NAME4
GO TO NAME2

NAME4:
IF X=Y THEN GO TO NAME4 ELSE GO TO NAME3

IF X=Y THEN GO TO NAME4
GO TO NAME3

IF X=Y THEN GO TO NAME4 ELSE X=2*Y

IF X<>Y THEN X=2*Y ELSE GO TO NAME4

END
```

```
10 REM NAME1:
20 REM NAME2:
30 REM NAME3:
40 ON X GOTO 20, 30, 40
50 REM
60 GOSUB NAME4: GOTO 30
70 GOSUB 110
80 GOTO 30
90 REM
100 REM NAME4:
110 IF X=Y THEN GOTO NAME4 ELSE GOTO 40
120 REM
130 IF X=Y THEN GOTO 110
140 GOTO 40
150 REM
160 IF X=Y THEN GOTO NAME4 ELSE X=2*Y
170 REM
180 IF X<>Y THEN X=2*Y ELSE GOTO 110
190 REM
200 END
```

Figure 4.

Each Tryname$ is compared, character by character, with the stored names, and a possible match is indicated if the end flag (255) is reached in the stored name. At Gtmtch (got match), the length is verified to be correct. If it is correct, the number of the stored name is built up, digit by digit, and put into the line (Short$) destined for the output file. When all names are matched and replaced, the line is passed to the code at Setfil.

The completed line is checked to see if it has (or had) an *erl* in it. If it hasn't previously been through, but it does have a reference to *erl*, the line is truncated and the right-hand end is saved. Now the name to which *erl* is to be compared is at the end of the line, and it is passed back into the name-checking code as if it had just been read from the input file. By the time the line is returned to Setfil, the name has been replaced with a number by the normal process and the right-hand end has been put back on the line; the line is then passed on to Outlin. Lines without *erl*, of course, are passed directly from near Setfil to Outlin, where the completely converted line is put into the .bas file.

Eventually, all the lines in the .wrk file get processed and the end-of-file error takes the program flow to Ndfil2, where the .bas file is closed and the program stops. During both passes, the program prints periods to the terminal so you'll know it isn't dead.

NOW IT'S YOURS, TOO

Figure 6 shows the program converted without comments—probably the easiest way for you to use it. Feel free to use it and copy it. My company requests, however, that out of courtesy you preserve the credits given in the first comment line. Good luck.

```
REM BSCBAS.BSC V2.01 3-83, Mark Gardner, WED ENTERPRISES, Glendale, CA 91201
PRINT ".BSC to .BAS converter, BSCBAS v2.01"

; BSCBAS.BSC  Source file for BSCBAS.BAS, BSCBAS.COM
; Programmer Mark R. Gardner 1982, 1983

; Copyright @1982 WED Enterprises, 1401 Flower Street, Glendale, CA 91201

; This program is to read a file in which "structured" basic has been
; written to a DIAGRAM specification.  This code searches and finds
; name definitions, numbers the lines, deletes comments (optional),
; and makes line number references match the names.  The rules are:
;
;       —names must be one to six characters long,
;         terminated by a colon (text following is ignored).
;
;       —name references must be standard BASIC, i.e., the name is on
;         the end of a line, preceded by one of these words:
;         GOTO, GO TO, GOSUB, RESUME, RESTORE.  The use of ERL
;         is allowed, it must be bracketed by a space at each end,
;         for example IF ERL <> INLINE THEN GO TO ERHAND.
;
;       —strings of names separated by commas are allowed,
;         no spaces!  This allow use of ON x GO TO name1,name2,name3,. . .)
;
; The DIAGRAM (or other comments) in the basic source file have a leading
; semicolon, but no number or REM statement. REM may be used for comments
; that the programmer wants to remain in the file even when stripped.
;
; The lines of code have no numbers.  Use of subroutines is encouraged.
; The standard extension for a file written for this is .BSC.
; See the author for comments, suggestions, or further instructions.

;> Note — version 2.01 has the following changes from version 2.00
;>    -The length of the possible names is compared against the length of
;>    stored names, see at NXTNAM.  (The old check was deleted from GTMTCH.)
;>    -A file is now produced (filename.BSN) which contains a list of the
;>    names and the line numbers assigned to them.  The number of names
;>    allowed is increased to 200, and the NUMBERS dimension increased to
;>    ,7 to allow for longer programs.  MRG 3-2-83

; Initialization section
INITLZ:
DIM NAMES(200,8)
DIM NUMBERS(200,7)
DIM WORDBOUND(2)
DIM TRYNAMES$(10)
```

```
GO TO BSCBAS
; SUBROUTINE NXTWRD
; Subroutine finds words in lines, working backwards.  Word boundaries
;    are returned to calling program.  Words are defined as being preceded
;    by a space, the search to the space beginning at the Ith position
;    in the line, set by the calling program.

NXTWRD:  FIND THE NEXT WORD (BACKWARDS) IN LINE
; If char is space, do
IF MID$(FILLIN$,I,1)<>" " THEN GO TO SETBND
;    decrease counter
I=I-1
;    move to next char (backwards)
GO TO NXTWRD
; Else
;    search for leading space
SETBND:  SET BOUNDARY 1
WORDBOUND(2)=I
LUKMOR:  LOOK MORE TOWARDS BEGINNING OF LINE
I=I-1
IF I=0 THEN ERROR 255
IF MID$(FILLIN$,I,1)<>" " THEN GO TO LUKMOR
WORDBOUND(1)=I+1
; End If char is space
RETURN

BSCBAS:  .BSC TO .BAS CONVERSION PROGRAM
;Get the filename and ask user for strip/nostrip options
INPUT "Name of file to run "; BSCNAMES$
OPEN "I",1,BSCNAMES$+".BSC"
OPEN "O",2,BSCNAMES$+".WRK"
OPEN "O",3,BSCNAMES$+".BSN"

INPUT "Strip comments and names (Y/N) "; ANSWERS$
STRIPFLAG=0
IF ANSWERS$="Y" THEN STRIPFLAG=1

; Put the header in the name file
PRINT#3, "NAME/LINE# ASSIGNMENTS FOR "+BSCNAMES$+".BAS      ";
IF STRIPFLAG THEN PRINT#3, "COMMENTS STRIPPED" ELSE PRINT#3,""

; Read through the file once, numbering lines and assigning line
; numbers to names as they are located.
NAMECTR=0
LINECTR=10
; Set up for end of file error to terminate pass one
ON ERROR GO TO ENDFIL

NXTLIN:  GET THE NEXT LINE FROM THE INPUT FILE
LINE INPUT#1, FILLIN$
; Give an "I'm alive" output
PRINT ".";

; If line is comment or blank line, then delete if strip flag set
IF LEN(FILLIN$)=0 THEN GO TO REMLIN
IF ASC(FILLIN$)=ASC(";") THEN GO TO REMLIN

; See if there is a name on the line
SRCHLIM=7
IF LEN(FILLIN$)<7 THEN SRCHLIM=LEN(FILLIN$)
FOR I=2 TO SRCHLIM
  LINCHR$=MID$(FILLIN$,I,1)
; If there is, store name and save line number
  IF LINCHR$=":" THEN GO TO NAMDEF
NEXT I
; Else, print the numbered line
GO TO PNLINE

NAMDEF:  HAVE FOUND A NAME DEFINITION LINE
; Store the length of the name
NAMES(NAMECTR,0)=I-1
; Store the name and its number in condensed form (not string)
FOR M=1 TO I-1
  NAMES(NAMECTR,M)=ASC(MID$(FILLIN$,M,1))
NEXT M
NAMES(NAMECTR,I)=255
; Note that if not stripping, the pointer is to line following name. .
;    This solves the possible problem with the RESTORE command
LINNMB$=STR$(LINECTR+10*(1-STRIPFLAG))
NUMLEN=LEN(LINNMB$)
FOR M=1 TO NUMLEN
  NUMBERS(NAMECTR,M-1)=ASC(MID$(LINNMB$,M,1))
NEXT M
NUMBERS(NAMECTR,NUMLEN)=255
; Print an assignment line to the names file
THENAMES$=LEFT$(FILLIN$,I-1)
PRINT#3, RIGHT$("      "+THENAMES$,6)+"      "+RIGHT$("      "+LINNMB$,6)
NAMECTR=NAMECTR+1
```

```
;Fall through to strip logic (name definition lines become comments)
REMLIN:  MAKE A REMARK LINE
; If the strip flag is set, don't include comment lines in the output
IF STRIPFLAG=1 THEN GO TO NXTLIN
; If not set, add the line number and REM, and put the line in the work file
PRINT#2, STR$(LINECTR)+" REM "+FILLIN$
; Increase the line number, go read the next input line
GO TO NUMLIN

; Add the line number and put the code line into work file
PNLINE:  PUT THE NUMBERED LINE
PRINT#2, STR$(LINECTR)+" "+FILLIN$
; Increase the line number, go read the next input line

NUMLIN:  CALCULATE THE LINE NUMBER
LINECTR=LINECTR+10
GO TO NXTLIN

; When the end of the input file is reached
ENDFIL:  END FILE ERROR ROUTES TO THIS ENTRY
;   Verify that the error is indeed EOF
IF ERR<>62 THEN ON ERROR GO TO 0
;   Notify user of progress
PRINT
PRINT "FIRST PASS COMPLETE, NAMES STORED"
;   Close files and continue to second pass
RESUME CLOSEM

CLOSEM:  CLOSE THE FILES
CLOSE

; Now, must go through the line numbered file, and find references to
;    names and replace them with the appropriate line numbers
; Reset error vector, in case trouble opening files
ON ERROR GO TO 0
OPEN "I",1,BSCNAME$+".WRK"
OPEN "O",2,BSCNAME$+".BAS"

; Set up for end of file error to terminate pass two
ON ERROR GO TO NDFIL2

; Take line from the input file for processing
; Line must be checked for RESUME, or GO TO, or GO TO, or GOSUB,
;    or RESTORE
NXLIN2:  NEXT LINE FROM WORK FILE
LINE INPUT#1, FILLIN$
; Set up for the process to handle ERL references
ERLFLAG=0

; See if is a comment line
FOR I=3 TO 7
IF MID$(FILLIN$,I,5)=" ; " THEN GO TO OUTLIN
NEXT I

PRCLIN:    PROCESS THE LINE
; Line is not a comment, find last word
I=LEN(FILLIN$)
GOSUB NXTWRD
; Get the word out of the line, is possible name
POSSNAME$=MID$(FILLIN$,WORDBOUND(1),WORDBOUND(2)-WORDBOUND(1)+1)
; Save the remainder of the line to add numbers to
SHORT$=LEFT$(FILLIN$,WORDBOUND(1)-1)
; Verify that possible name has alphabetic first character
; If not, put the line in the output file unmodified
IF ASC(POSSNAME$)<ASC("A") THEN GO TO OUTLIN
IF ASC(POSSNAME$)>ASC("Z") THEN GO TO OUTLIN

; If processing an ERL reference
IF ERLFLAG<>2 GO TO FNDNLT
;    Proceed directly to check name (no need to verify command)
GO TO CHKNAM
; End if (processing ERL ref)
; Find the next to last word
FNDNLT:  FIND THE NEXT TO LAST WORD
I=WORDBOUND(1)-1
GOSUB NXTWRD
; Get the word out of the line, is possible command
POSSCOMD$=MID$(FILLIN$,WORDBOUND(1),WORDBOUND(2)-WORDBOUND(1)+1)
; Determine if is one of commands preceding names. . .
IF POSSCOMD$="GOTO" THEN GO TO CHKNAM
IF POSSCOMD$="GOSUB" THEN GO TO CHKNAM
IF POSSCOMD$="RESUME" THEN GO TO CHKNAM
IF POSSCOMD$="RESTORE" THEN GO TO CHKNAM
; If the possible command is TO, see if preceding word is GO
IF POSSCOMD$<>"TO" THEN GO TO OUTLIN
I=WORDBOUND(1)-1
GOSUB NXTWRD
POSSCOMD$=MID$(FILLIN$,WORDBOUND(1),WORDBOUND(2)-WORDBOUND(1)+1)
```

```
; If it is GO, then proceed to check name, otherwise put line in output file
IF POSSCOMD$<>"GO" THEN GO TO OUTLIN

CHKNAM:  CHECK NAME
; Check POSSNAME$ for commas (makes it a multiple name. . .)
NUMOFNAMES=1
COMMAPTR=1
FOR I=1 TO LEN(POSSNAME$)
  IF MID$(POSSNAME$,I,1)="," THEN GO TO INCNNM
  GO TO MOVLET

; If a comma is found, store the name-to-try, and increase name counter
INCNNM:  INCREASE THE NUMBER OF NAMES
  TRYNAME$(NUMOFNAMES)=MID$(POSSNAME$,COMMAPTR,I-COMMAPTR)
  NUMOFNAMES=NUMOFNAMES+1
  COMMAPTR=I+1
MOVLET:  MOVE TO NEXT LETTER
NEXT I
; Save the last (or only) name in the string
TRYNAME$(NUMOFNAMES)=MID$(POSSNAME$,COMMAPTR,LEN(POSSNAME$))

; Now, analyze all the names-to-try, see if defined
TRYNAMEPTR=1

PIKNAM:  PICK ANOTHER NAME
POSSNAME$=TRYNAME$(TRYNAMEPTR)
I=0

NXTNAM:  MOVE TO NEXT NAME, FIRST LETTER
; See if length of names matches
IF NAMES(I,0)<>LEN(TRYNAME$(TRYNAMEPTR)) THEN GO TO TRYNAM

J=1
IF NAMECTR=0 THEN GO TO NOMTCH

TRYNTR:  TRY ANOTHER LETTER
; If names value is 255, then we have a match, check first letters
IF NAMES(I,J)=255 THEN GO TO GTMTCH
; If names value not 255, see if is next character of name
; If it is, continue to next letter, if not, go try another name
IF ASC(MID$(POSSNAME$,J,1))<>NAMES(I,J) THEN GO TO TRYNAM
J=J+1
IF J<8 THEN GO TO TRYNTR

TRYNAM:  TRY ANOTHER NAME
; Move on to next name in stored set
I=I+1
; If no more, then must assume no match
IF I<=NAMECTR THEN GO TO NXTNAM

NOMTCH:  NO MATCH FOR NAME
; Give the user a no match message
PRINT
PRINT POSSNAME$ " HAS NO MATCH"
; Put the line plus a warning into the output file
IF LEN(FILLIN$)>=60 GO TO LONLIN
FILLIN$=FILLIN$+SPACE$(60-LEN(FILLIN$))+" NO DEF: "+POSSNAME$
GO TO ENDNMS
LONLIN:  LINE IS TOO LONG FOR ORDINARY WARNING
FILLIN$=FILLIN$+" NO DEF: "+POSSNAME$
ENDNMS:  END OF NO MATCH MESSAGE GENERATOR
GO TO OUTLIN

GTMTCH:  GOT A MATCH TO A STORED NAME
; If here, have matched a name in source line with stored name
; Convert the stored line number for name, add to building line
FOR J=0 TO 6
  IF NUMBERS(I,J)=255 THEN GO TO INCTRY
  SHORT$=SHORT$+CHR$(NUMBERS(I,J))
NEXT J
; If there is not a flag in the stored number array, give error message
PRINT "INVALID NUMBER ENTRY"
STOP
; If there are any more names on this line, add a comma and proceed to next
INCTRY:  INCREASE THE TRY-NAME POINTER
TRYNAMEPTR=TRYNAMEPTR+1
IF TRYNAMEPTR>NUMOFNAMES THEN GO TO SETFIL
SHORT$=SHORT$+","
GO TO PIKNAM

; If there are no more names, put the fully converted line to output file
SETFIL:  SET THE FILE LINE TO EQUAL THE ASSEMBLED SHORT LINE
FILLIN$=SHORT$

; If the line has not been checked for ERL
IF ERLFLAG<>0 THEN GO TO ERLDON
;    Set the ERL flag to 1 (means check made)
ERLFLAG=1
```

```
;     If the line contains an ERL reference
ERLPTR=INSTR(FILLIN$," ERL ")
IF ERLPTR=0 GO TO ERLDON
;       Set ERL flag to 2
ERLFLAG=2
;       Find the end of the word to right of ERL
ERLPTR=ERLPTR+4
;         (Find the beginning of the word)
SEARCHFLAG=1
NOWORD=0
WHILE SEARCHFLAG
ERLPTR=ERLPTR+1
IF ERLPTR>LEN(FILLIN$) THEN SEARCHFLAG=0: NOWORD=1: GO TO SRCHND
TEST$=MID$(FILLIN$,ERLPTR,1)
IF (TEST$>="A" AND TEST$<="Z") THEN SEARCHFLAG=0
SRCHND:  SEARCH END (FOR FIRST LETTER OF NAME)
WEND
;         (Find the next space)
IF NOWORD GO TO OUTLIN
WHILE MID$(FILLIN$,ERLPTR,1)<>" "
  ERLPTR=ERLPTR+1
WEND
;       Save rightmost part of line, leaving that word last
ERLSAV$=RIGHT$(FILLIN$,LEN(FILLIN$)-ERLPTR+1)
FILLIN$=LEFT$(FILLIN$,ERLPTR-1)
;       Go and process with standard line process
GO TO PRCLIN
;     End if (the line contains an ERL reference)
; Else (the line has been checked)
ERLDON:  THE ERL CHECK HAS BEEN DONE
;     If ERL flag is 2
IF ERLFLAG<>2 THEN GO TO OUTLIN
;       Append the previously saved right part of line
FILLIN$=FILLIN$+ERLSAV$
;     Else
;       Proceed directly to the line output
;     End if (ERL flag is 2)
; End if (the line has not been checked for ERL)

OUTLIN:  OUTPUT THE LINE TO THE .BAS FILE
PRINT#2,FILLIN$
PRINT ".";
; And go get the next line from the input file
GO TO NXLIN2
; If the conversion process is finished
NDFIL2:  SECOND END OF FILE ENTRY POINT
;     Close the files
CLOSE
IF ERR<>62 THEN ON ERROR GO TO 0
;     Delete the work file
KILL BSCNAME$+".WRK"
RESUME LOADRQ
LOADRQ:  INVITATION TO LOAD (no longer used)
STOP

END
```

Figure 5.

```
10 REM BSCBAS.BSC V2.01 3-83, Mark Gardner, WED ENTERPRISES, Glendale, CA 91201
20 PRINT ".BSC to .BAS converter, BSCBAS v2.01"
30 DIM NAMES(200,8)
40 DIM NUMBERS(200,7)
50 DIM WORDBOUND(2)
60 DIM TRYNAME$(10)
70 GO TO 170
80 IF MID$(FILLIN$,I,1)<>" " THEN GO TO 110
90 I=I-1
100 GO TO 80
110 WORDBOUND(2)=I
120 I=I-1
130 IF I=0 THEN ERROR 255
140 IF MID$(FILLIN$,I,1)<>" " THEN GO TO 120
150 WORDBOUND(1)=I+1
160 RETURN
170 INPUT "Name of file to run "; BSCNAME$
180 OPEN "I",1,BSCNAME$+".BSC"
190 OPEN "O",2,BSCNAME$+".WRK"
200 OPEN "O",3,BSCNAME$+".BSN"
210 INPUT "Strip comments and names (Y/N) "; ANSWER$
220 STRIPFLAG=0
230 IF ANSWER$="Y" THEN STRIPFLAG=1
240 PRINT#3, "NAME/LINE# ASSIGNMENTS FOR "+BSCNAME$+".BAS        ";
250 IF STRIPFLAG THEN PRINT#3, "COMMENTS STRIPPED" ELSE PRINT#3,""
260 NAMECTR=0
270 LINECTR=10
280 ON ERROR GO TO 600
290 LINE INPUT#1, FILLIN$
300 PRINT ".";
310 IF LEN(FILLIN$)=0 THEN GO TO 540
320 IF ASC(FILLIN$)=ASC(";") THEN GO TO 540
330 SRCHLIM=7
340 IF LEN(FILLIN$)<7 THEN SRCHLIM=LEN(FILLIN$)
350 FOR I=2 TO SRCHLIM
360    LINCHR$=MID$(FILLIN$,I,1)
370    IF LINCHR$=":" THEN GO TO 400
380 NEXT I
390 GO TO 570
400 NAMES(NAMECTR,0)=I-1
410 FOR M=1 TO I-1
420    NAMES(NAMECTR,M)=ASC(MID$(FILLIN$,M,1))
430 NEXT M
440 NAMES(NAMECTR,I)=255
450 LINNMB$=STR$(LINECTR+10*(1-STRIPFLAG))
460 NUMLEN=LEN(LINNMB$)
470 FOR M=1 TO NUMLEN
480    NUMBERS(NAMECTR,M-1)=ASC(MID$(LINNMB$,M,1))
490 NEXT M
500 NUMBERS(NAMECTR,NUMLEN)=255
510 THENAME$=LEFT$(FILLIN$,I-1)
520 PRINT#3, RIGHT$("      "+THENAME$,6)+"      "+RIGHT$("      "+LINNMB$,6)
530 NAMECTR=NAMECTR+1
540 IF STRIPFLAG=1 THEN GO TO 290
550 PRINT#2, STR$(LINECTR)+" REM "+FILLIN$
560 GO TO 580
570 PRINT#2, STR$(LINECTR)+" "+FILLIN$
580 LINECTR=LINECTR+10
590 GO TO 290
600 IF ERR<>62 THEN ON ERROR GO TO 0
610 PRINT
620 PRINT "FIRST PASS COMPLETE, NAMES STORED"
630 RESUME 640
640 CLOSE
650 ON ERROR GO TO 0
660 OPEN "I",1,BSCNAME$+".WRK"
670 OPEN "O",2,BSCNAME$+".BAS"
680 ON ERROR GO TO 1600
690 LINE INPUT#1, FILLIN$
700 ERLFLAG=0
710 FOR I=3 TO 7
720 IF MID$(FILLIN$,I,3)=" ; " THEN GO TO 1570
730 NEXT I
740 I=LEN(FILLIN$)
750 GOSUB 80
760 POSSNAME$=MID$(FILLIN$,WORDBOUND(1),WORDBOUND(2)-WORDBOUND(1)+1)
```

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```
770 SHORT$=LEFT$(FILLIN$,WORDBOUND(1)-1)
780 IF ASC(POSSNAME$)ASC("A") THEN GO TO 1570
790 IF ASC(POSSNAME$)>ASC("Z") THEN GO TO 1570
800 IF ERLFLAG<>2 GO TO 820
810 GO TO 940
820 I=WORDBOUND(1)-1
830 GOSUB 80
840 POSSCOMD$=MID$(FILLIN$,WORDBOUND(1),WORDBOUND(2)-WORDBOUND(1)+1)
850 IF POSSCOMD$="GOTO" THEN GO TO 940
860 IF POSSCOMD$="GOSUB" THEN GO TO 940
870 IF POSSCOMD$="RESUME" THEN GO TO 940
880 IF POSSCOMD$="RESTORE" THEN GO TO 940
890 IF POSSCOMD$<>"TO" THEN GO TO 1570
900 I=WORDBOUND(1)-1
910 GOSUB 80
920 POSSCOMD$=MID$(FILLIN$,WORDBOUND(1),WORDBOUND(2)-WORDBOUND(1)+1)
930 IF POSSCOMD$<>"GO" THEN GO TO 1570
940 NUMOFNAMES=1
950 COMMAPTR=1
960 FOR I=1 TO LEN(POSSNAME$)
970    IF MID$(POSSNAME$,I,1)="," THEN GO TO 990
980    GO TO 1020
990    TRYNAME$(NUMOFNAMES)=MID$(POSSNAME$,COMMAPTR,I-COMMAPTR)
1000    NUMOFNAMES=NUMOFNAMES+1
1010    COMMAPTR=I+1
1020 NEXT I
1030 TRYNAME$(NUMOFNAMES)=MID$(POSSNAME$,COMMAPTR,LEN(POSSNAME$))
1040 TRYNAMEPTR=1
1050 POSSNAME$=TRYNAME$(TRYNAMEPTR)
1060 I=0
1070 IF NAMES(I,0)<>LEN(TRYNAME$(TRYNAMEPTR)) THEN GO TO 1140
1080 J=1
1090 IF NAMECTR=0 THEN GO TO 1160
1100 IF NAMES(I,J)=255 THEN GO TO 1230
1110 IF ASC(MID$(POSSNAME$,J,1))<>NAMES(I,J) THEN GO TO 1140
1120 J=J+1
1130 IF J8 THEN GO TO 1100
1140 I=I+1
1150 IF I=NAMECTR THEN GO TO 1070
1160 PRINT
1170 PRINT POSSNAME$ " HAS NO MATCH"
1180 IF LEN(FILLIN$)>=60 GO TO 1210
1190 FILLIN$=FILLIN$+SPACE$(60-LEN(FILLIN$))+" NO DEF: "+POSSNAME$
1200 GO TO 1220
1210 FILLIN$=FILLIN$+" NO DEF: "+POSSNAME$
1220 GO TO 1570
1230 FOR J=0 TO 6
1240    IF NUMBERS(I,J)=255 THEN GO TO 1290
1250    SHORT$=SHORT$+CHR$(NUMBERS(I,J))
1260 NEXT J
1270 PRINT "INVALID NUMBER ENTRY"
1280 STOP
1290 TRYNAMEPTR=TRYNAMEPTR+1
1300 IF TRYNAMEPTR>NUMOFNAMES THEN GO TO 1330
1310 SHORT$=SHORT$+","
1320 GO TO 1050
1330 FILLIN$=SHORT$
1340 IF ERLFLAG<>0 THEN GO TO 1550
1350 ERLFLAG=1
1360 ERLPTR=INSTR(FILLIN$," ERL ")
1370 IF ERLPTR=0 GO TO 1550
1380 ERLFLAG=2
1390 ERLPTR=ERLPTR+4
1400 SEARCHFLAG=1
1410 NOWORD=0
1420 WHILE SEARCHFLAG
1430 ERLPTR=ERLPTR+1
1440 IF ERLPTRffLEN(FILLIN$) THEN SEARCHFLAG=0: NOWORD=1: GO TO 1470
1450 TEST$=MID$(FILLIN$,ERLPTR,1)
1460 IF (TEST$)>="A" AND TEST$<="Z") THEN SEARCHFLAG=0
1470 WEND
1480 IF NOWORD GO TO 1570
1490 WHILE MID$(FILLIN$,ERLPTR,1)<>" "
1500    ERLPTR=ERLPTR+1
1510 WEND
1520 ERLSAV$=RIGHT$(FILLIN$,LEN(FILLIN$)-ERLPTR+1)
1530 FILLIN$=LEFT$(FILLIN$,ERLPTR-1)
1540 GO TO 740
1550 IF ERLFLAG<>2 THEN GO TO 1570
1560 FILLIN$=FILLIN$+ERLSAV$
1570 PRINT#2,FILLIN$
1580 PRINT ".";
1590 GO TO 690
1600 CLOSE
1610 IF ERR<>62 THEN ON ERROR GO TO 0
1620 KILL BSCNAME$+".WRK"
1630 RESUME 1640
1640 STOP
1650 END
```

▲

Figure 6.

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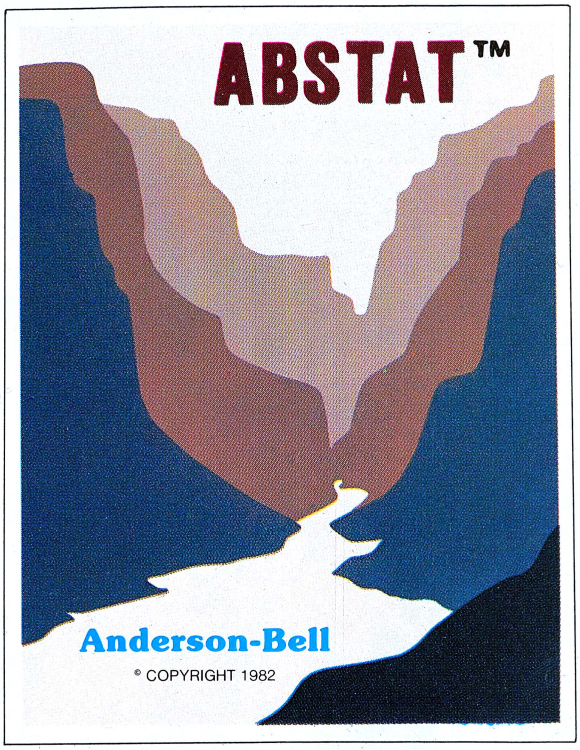

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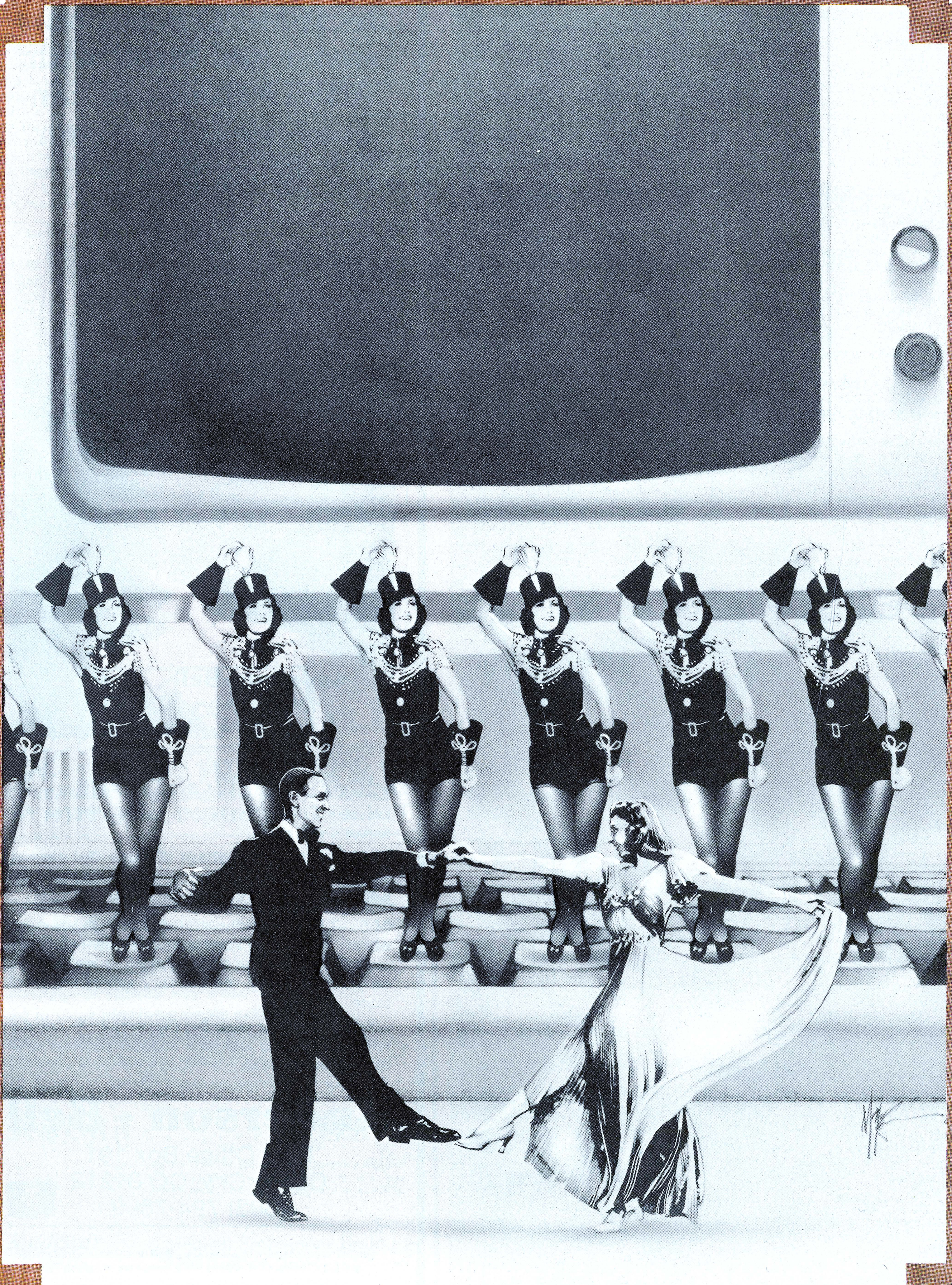

SOCHA'S TOOLBOX • BY JOHN SOCHA

Enhance YOUR KEYBOARD BUFFER

This is an informal series of articles on a variety of subjects. The emphasis will be on short, useful machine-language programs you can enter with the help of Basic programs. Where do I get my ideas? From necessity, from friends, and from you, dear reader. If you have any requests for programs or articles, please write to John Socha, c/o Softalk/IBM, Box 60, North Hollywood, CA 91603.

Inside your IBM pc is an area in memory where characters are stored as you type them. But this memory area, or buffer as it's known, is limited to fifteen characters. At one time fifteen characters sounded like more than enough, but that was back when people were using computers with very small buffers—like one character.

But now that we've been spoiled by a longer buffer, wouldn't it be nice to have an even larger one? We've got lots of memory to play with, so why not make the buffer 159 characters long? And wouldn't it also be nice to have some way to clear this buffer from the keyboard?

The program presented in this article will increase your buffer size to 159 characters, so while DOS is carrying out a command, you can type a long sequence of other commands and then walk away while DOS is still churning out the first one.

You don't need any knowledge of machine language to read this article and extend the keyboard buffer. All you need is some patience and Basic; or, you can send your name and address, along with a check for $8, to Softalk Buffer, Box 60, North Hollywood, CA 91603. We'll send you the program on disk.

Buffer, What's That? DOS doesn't actually work directly with the keyboard buffer. Instead it uses a set of routines—similar in idea to Basic subroutines—in the ROM (Read Only Memory) BIOS (Basic Input/Output System).

These ROM BIOS routines are used to talk to various physical devices, such as the keyboard.

The word ROM means these routines are stored in a computer chip where they can't be changed, only read. We'll have to be somewhat clever if we want to change the size of the keyboard buffer, since its size is set in silicon inside the ROM chip.

If the ROM BIOS stores characters in memory, we should be able to find them, right? Right. Here is a Basic program that looks at the keyboard buffer and displays its current contents.

```
10 DEF SEG=0
20 FOR I=0 TO 15
30 PRINT CHR$(PEEK(&H41E +
   I+I));
40 NEXT I
50 END
```

The keyboard buffer stores two bytes for each character: the character's scan code and its ASCII value. Why does it store both pieces of information? Because whenever you hit one of the pc's special keys (such as F1), which are not part of the ASCII character set, the ROM BIOS sets the character byte to 0 and the other byte to the scan code—or the extended code, as it's called in the Basic manual. This is how other programs know you've pushed one of these special keys.

Let's try a specific example with this Basic program. Type the underscored text, and where it says ⟨F2⟩, push the F2 key:

```
this is a long line
Syntax error
Ok
⟨F2⟩RUN
line
 is a long
Ok
```

That's it, we've found the keyboard buffer in memory. Not all the characters from "this is a long line" are here, since the buffer can store only the last fifteen characters, and the F2 key is one of these characters. Typing "this is a long line" placed these characters into the buffer, one after the other, and Basic read them as we typed them. "this is a long line" is not a Basic command, so Basic complains—but no harm done; we just wanted to place some characters into the buffer.

Stretching the Buffer. Before we look at the magic behind Kbd_fix.com—the program to stretch the keyboard buffer—let's build Kbd_fix.com and put it through some tests.

Listing 1 shows a Basic program that automatically writes Kbd_fix.com to your disk using the data in its data statements.

If you make an error entering the *data* statements, the program will tell you which line is wrong. Check the other statements carefully, though; there are no checks on them.

You need run this program only once to build Kbd_fix.com, but you may wish to save it on your disk just in case Kbd_fix.com doesn't work correctly; you might have an error in your program. If this should happen, carefully check lines 10 through 350.

Kbd_fix.com is a machine-language program that attaches itself to DOS each time you invoke it; but only run it once each time you

```
10 DIM CHECK(48)
20 FOR I=1 TO 48 : CHECK(I)=0 : NEXT I
30 PRINT "Checking";
40 FOR I=1 TO 48
50   FOR J=1 TO 8
60     READ BYTE
70     CHECK(I) = CHECK(I) XOR BYTE
80   NEXT J
90   PRINT ".";
100 NEXT I
110 PRINT
120 LINECHECK=0
130 FOR I=1 TO 48
140   READ CHECK
150   LINECHECK = LINECHECK XOR CHECK
160   IF CHECK(I) <> CHECK THEN PRINT "Data in Line";1000+10*(I-1);"may be bad."
170 NEXT I
180 IF LINECHECK <> 228 THEN PRINT "Data bad in lines 2010-2060."
190 OPEN "kbd_fix.com" AS #1 LEN=1
200 PRINT "Writing. . ."
210 FIELD #1,1 AS BYTE$
220 RESTORE
230 FOR I=1 TO 16       'Read the first part of Kbd_fix.com
240   READ BYTE : LSET BYTE$ = CHR$(BYTE) : PUT #1
250 NEXT I
260 LSET BYTE$ = CHR$(0)
270 FOR I=1 TO 312      '160 character keyboard buffer
280   PUT #1
290 NEXT I
300 FOR I=1 TO 368      'Read the last part of Kbd_fix.com
310   READ BYTE : LSET BYTE$ = CHR$(BYTE) : PUT #1
320 NEXT I
330 CLOSE
340 PRINT "KBD_FIX.COM created"
350 END
1000 DATA     233,  91,   2,    0,    0,    0,    0,    0
1010 DATA     0,    0,    0,    15,   1,    15,   1,    0
1020 '312 bytes of 0s
1030 DATA     0,    0,    0,    0,    0,    0,    0,    80
1040 DATA     83,   81,   156,  250,  187,  30,   0,    228
1050 DATA     97,   80,   36,   252,  230,  97,   185,  60
1060 DATA     0,    226,  254,  12,   2,    230,  97,   185
1070 DATA     60,   0,    226,  254,  75,   117,  235,  88
1080 DATA     230,  97,   157,  89,   91,   88,   195,  187
1090 DATA     64,   0,    142,  219,  250,  139,  30,   26
1100 DATA     0,    59,   30,   28,   0,    117,  29,   187
1110 DATA     30,   0,    137,  30,   26,   0,    131,  195
1120 DATA     2,    137,  30,   28,   0,    140,  203,  142
1130 DATA     219,  187,  15,   1,    137,  30,   11,   1
1140 DATA     137,  30,   13,   1,    251,  195,  30,   86
1150 DATA     83,   80,   232,  202,  255,  156,  46,   255
1160 DATA     30,   3,    1,    187,  64,   0,    142,  219
1170 DATA     46,   139,  54,   13,   1,    139,  30,   26
1180 DATA     0,    131,  195,  2,    131,  251,  62,   114
1190 DATA     3,    187,  30,   0,    59,   30,   28,   0
1200 DATA     116,  38,   139,  7,    46,   137,  4,    131
1210 DATA     198,  2,    129,  254,  79,   2,    114,  3
1220 DATA     190,  15,   1,    46,   59,   54,   11,   1
1230 DATA     117,  5,    232,  98,   255,  235,  5,    46
1240 DATA     137,  54,   13,   1,    137,  30,   26,   0
1250 DATA     160,  23,   0,    36,   12,   60,   12,   117
1260 DATA     8,    46,   161,  13,   1,    46,   163,  11
1270 DATA     1,    88,   91,   94,   31,   207,  251,  30
1280 DATA     83,   232,  99,   255,  140,  203,  142,  219
1290 DATA     10,   228,  116,  11,   254,  204,  116,  41
1300 DATA     254,  204,  116,  54,   91,   31,   207,  251
1310 DATA     144,  250,  139,  30,   11,   1,    59,   30
1320 DATA     13,   1,    116,  243,  139,  7,    131,  195
1330 DATA     2,    129,  251,  79,   2,    117,  3,    187
1340 DATA     15,   1,    137,  30,   11,   1,    91,   31
1350 DATA     207,  250,  139,  30,   11,   1,    59,   30
1360 DATA     13,   1,    139,  7,    251,  91,   31,   202
1370 DATA     2,    0,    255,  46,   7,    1,    30,   184
1380 DATA     0,    0,    142,  216,  250,  161,  36,   0
1390 DATA     46,   163,  3,    1,    161,  38,   0,    46
1400 DATA     163,  5,    1,    199,  6,    36,   0,    166
1410 DATA     2,    140,  14,   38,   0,    251,  161,  88
1420 DATA     0,    46,   163,  7,    1,    161,  90,   0
1430 DATA     46,   163,  9,    1,    199,  6,    88,   0
1440 DATA     14,   3,    140,  14,   90,   0,    184,  64
1450 DATA     0,    142,  216,  250,  187,  30,   0,    137
1460 DATA     30,   26,   0,    199,  7,    0,    0,    131
1470 DATA     195,  2,    137,  30,   28,   0,    251,  186
1480 DATA     94,   3,    205,  39,   0,    0,    0,    0
2000 '
2010 DATA     176,  0,    80,   37,   235,  44,   173,  56
2020 DATA     96,   234,  211,  64,   243,  235,  147,  178
2030 DATA     16,   118,  159,  254,  135,  153,  197,  62
2040 DATA     218,  13,   105,  53,   254,  0,    208,  71
2050 DATA     248,  215,  143,  245,  115,  41,   38,   228
2060 DATA     164,  112,  28,   45,   128,  71,   11,   183
```

Listing 1.

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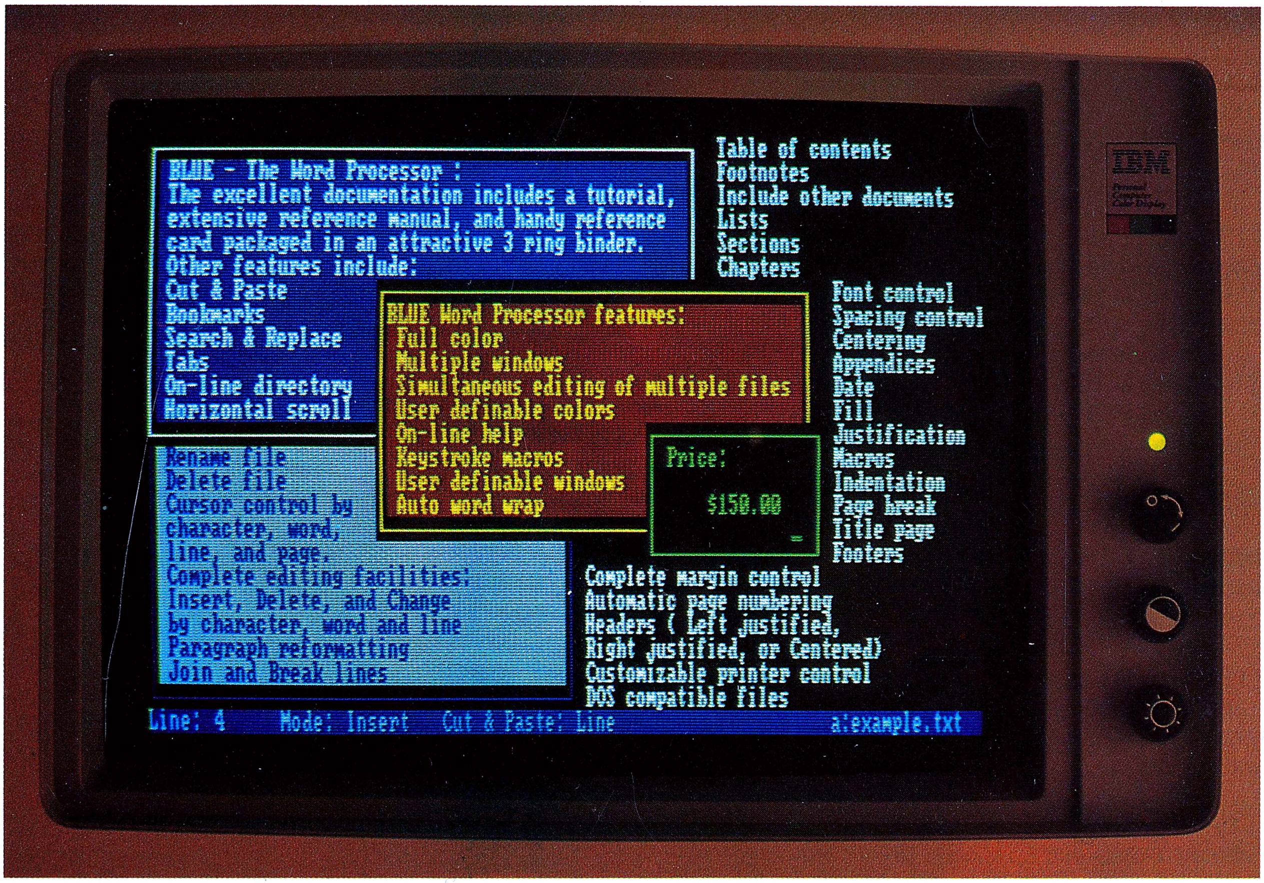

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start DOS. To attach Kbd_fix.com to DOS and stretch the keyboard buffer, just type *kbd_fix* after the DOS prompt. But don't do it just yet.

You'll want to place the line *kbd_fix* in your Autoexec.bat file to run Kbd_fix.com once each time you restart DOS. If you're also using Scrollk (see "The Scroll Lock Mystery Solved," *Softalk*, May 1983), run Kbd_fix before Scrollk. And if you're using *ProKey*, run Kbd_fix and Scrollk before you load *ProKey*. For example, if you're using all three programs, your Autoexec.bat file might look like this:

```
KBD_FIX
SCROLLK
PROKEY/I
```

Don't See No Difference. So what happens when we type *kbd_fix* to attach it to DOS? Not much, except that we lose some memory:

```
A>CHKDSK
  362496 bytes total disk space
   22528 bytes in 2 hidden files
  322560 bytes in 27 user files
    5120 bytes in bad sectors
   12288 bytes available on disk
  393216 bytes total memory
  170192 bytes free

A>KBD_FIX

A>CHKDSK
  362496 bytes total disk space
   22528 bytes in 2 hidden files
  322560 bytes in 27 user files
    5120 bytes in bad sectors
   12288 bytes available on disk
  393216 bytes total memory
  169424 bytes free

A>
```

We've lost about 700 bytes of free memory. To see how Kbd_fix has changed DOS we need to take a closer look—with the help of another machine language program.

Looking under the Magic Hat. The following Basic program builds the machine-language program Testkbd.com, which we'll use to see our stretched keyboard buffer.

```
10 OPEN "testkbd.com" AS #1
   LEN=1
20 FIELD #1,1 AS BYTE$
30 FOR I=1 TO 14
40  READ BYTE : LSET BYTE$ = CHR$(BYTE) : PUT #1
50 NEXT I
60 END
100 '
110 DATA 184,   64,   0,    142,  216,  246,  6,    23
120 DATA 0,     1,    116,  249,  205,  32
```

When you're back in DOS, type *Testkbd*. This program waits patiently until you hit the right-hand shift key before it returns control to DOS. Push the right-hand shift key and you'll see the DOS prompt appear.

Now run Testkbd again and start typing characters. When you've typed several lines' worth, hit the right shift key again. If you count them, you'll find you've typed 159 characters before your pc starts to beep; all 159 characters are in the buffer. If you hit the right shift key now, you'll see the first 137 characters appear before DOS starts to object. DOS can only read 137 characters in one line.

But what if we want to erase the buffer? Again run Testkbd and type a long string of characters. But before you hit the right-hand shift key, push control-alt—that is, push the control and alt keys at the same time. This clears the keyboard buffer. Now when you push the right shift key you'll find the buffer empty.

The Trick. Each time you push or release a key, your keyboard sends a signal to your pc. This signal, called an interrupt, causes the 8088 to run a short procedure in the ROM BIOS, which reads the scan code from the keyboard and converts this to a character. The ROM BIOS interrupt procedure stuffs this character into its fifteen-character buffer.

Kbd_fix intercepts all interrupt calls to this ROM BIOS interrupt procedure, as well as to another BIOS procedure DOS uses to read characters. Kbd_fix checks the BIOS's fifteen-character buffer after each interrupt to see if there is a character waiting to be read. If there is, it reads this character and places it into its own 159-character buffer. Kbd_io replaces the other ROM BIOS procedure, so when DOS, or any other program, calls the BIOS asking for a character, Kbd_fix hands over one character from its 159-character buffer.

Kbd_fix also watches for the control-alt pair of keys by staking out memory location 417H—which reflects the state of the four shift keys: left shift, right shift, alt shift, and control shift. For more information on these flags, see "The Scroll Lock Mystery Solved" in the May 1983 issue.

That, in a nutshell, is the secret behind Kbd_fix.com.

The Picky Details. There is one last important detail added to Kbd_fix.com. Many programs clear the ROM BIOS's fifteen-character buffer and expect by doing so to remove all characters. Since we are now storing characters in Kbd_fix's internal 159-character buffer, we must be careful to check for a cleared buffer. Kbd_fix does that, and if it sees that the ROM BIOS's fifteen-character buffer has been cleared, it clears its own buffer. Kbd_fix should work with almost all programs.

You can find the gory details of Kbd_fix in the assembly language listing (listing 2). Kbd_fix keeps a dummy character in the buffer so it can check if another program has tried to clear the buffer. The other details are explained to varying degrees in the listing.

Finally, in listing 3 you'll find the simple program Testkbd; so you can see how it works.

```
VECTORS                 SEGMENT         AT 0H
            ORG         9H*4
KEYBOARD_INT_VECTOR                     LABEL           DWORD
            ORG         16H*4
KEYBOARD_IO_VECTOR                      LABEL           DWORD
VECTORS                 ENDS

ROM_BIOS_DATA           SEGMENT         AT 40H
            ORG         17H
KBD_FLAG                DB              ?
            ORG         1AH
ROM_BUFFER_HEAD         DW              ?
ROM_BUFFER_TAIL         DW              ?
KB_BUFFER               DW              16 DUP          (?)
KB_BUFFER_END           LABEL           WORD
ROM_BIOS_DATA           ENDS

CODE_SEG                SEGMENT
            ASSUME      CS:CODE_SEG
            ORG         100H
BEGIN:      JMP         INIT_VECTORS                                    ;Initialize vectors and attach to DOS

ROM_KEYBOARD_INT                        DD                              ;Address for ROM routine
ROM_KEYBOARD_IO                         DD
BUFFER_HEAD                             DW              OFFSET KEYBOARD_BUFFER
BUFFER_TAIL                             DW              OFFSET KEYBOARD_BUFFER
KEYBOARD_BUFFER                         DW              160 DUP (0)     ;159 character input buffer
KEYBOARD_BUFFER_END                     LABEL           WORD

;-----------------------------------------------------------------------;
; This procedure sends a short beep when the buffer fills.              ;
;-----------------------------------------------------------------------;

K B _ CONTROL           EQU             61H             ;Control bits for keyboard (and speaker)
ERROR_BEEP              PROC            NEAR
            PUSH        AX
            PUSH        BX
            PUSH        CX
            PUSHF                                       ;Save the old interrupt enable flag
            CLI                                         ;Turn off beep during interrupt
            MOV         BX,30                           ;Number of cycles for 1/8 second tone
            IN          AL,KB_CONTROL                   ;Get control information from speaker port
            PUSH        AX                              ;Save the control information
START_OF_ONE_CYCLE:
            AND         AL,0FCH                         ;Turn off the speaker
            OUT         KB_CONTROL,AL
            MOV         CX,60                           ;Delay for one half cycle
```

```
OFF_LOOP:
          LOOP        OFF_LOOP
          OR          AL,2                    ;Turn on the speaker
          OUT         KB_CONTROL,AL
          MOV         CX,60                   ;Delay for second half cycle
ON_LOOP:
          LOOP        ON_LOOP
          DEC         BX                      ;200 cycles yet?
          JNZ         START_OF_ONE_CYCLE
          POP         AX                      ;Recover old keyboard information
          OUT         KB_CONTROL,AL
          POPF                                ;Restore interrupt flag
          POP         CX
          POP         BX
          POP         AX
          RET
ERROR_BEEP            ENDP
;-------------------------------------------------------------;
; This procedure checks the ROM keyboard buffer to see if some program  ;
; tried to clear this buffer. We know it's been cleared when the ROM    ;
; tail and header overlap. Normally, the new procedures below keep the  ;
; dummy character, word 0, in the buffer.                               ;
;                                                                       ;
; Uses: BX, DS                                                          ;
; Writes:     BUFFER_HEAD, BUFFER_TAIL, ROM_BUFFER_HEAD,               ;
;             ROM_BUFFER_TAIL                                           ;
; Reads:      KEYBOARD_BUFFER, KB_BUFFER                                ;
;-------------------------------------------------------------;
CHECK_CLEAR_BUFFER                    PROC    NEAR
          ASSUME      DS:ROM_BIOS_DATA
          MOV         BX,ROM_BIOS_DATA        ;Establish pointer to BIOS data
          MOV         DS,BX
          CLI                                 ;Turn off interrupts during this check
          MOV         BX,ROM_BUFFER_HEAD      ;Check to see if buffer cleared
          CMP         BX,ROM_BUFFER_TAIL      ;Is the buffer empty?
          JNE         BUFFER_OK               ;No, then everything is alright
                                              ;Yes, then clear the internal buffer
          MOV         BX,OFFSET KB_BUFFER     ;Reset the buffer with word 0 in buffer
          MOV         ROM_BUFFER_HEAD,BX
          ADD         BX,2
          MOV         ROM_BUFFER_TAIL,BX
          ASSUME      DS:CODE_SEG
          MOV         BX,CS
          MOV         DS,BX
          MOV         BX,OFFSET KEYBOARD_BUFFER           ;Reset internal buffer
          MOV         BUFFER_HEAD,BX
          MOV         BUFFER_TAIL,BX
```

```
BUFFER_OK:
          ASSUME      DS:CODE_SEG
          STI                                             ;Interrupts back on
          RET
CHECK_CLEAR_BUFFER                    ENDP

;-----------------------------------------------------------------------;
; This procedure intercepts the keyboard interrupt and moves any new    ;
; characters to the internal, 80 character, buffer.                     ;
;-----------------------------------------------------------------------;

INTERCEPT_KEYBOARD_INT  PROC     NEAR
          ASSUME      DS:NOTHING
          PUSH        DS
          PUSH        SI
          PUSH        BX
          PUSH        AX
          CALL        CHECK_CLEAR_BUFFER          ;Check for buffer cleared
          PUSHF
          CALL        ROM_KEYBOARD_INT            ;Read scan code with BIOS routines
;------   Transfer any characters to internal buffer

          ASSUME      DS:ROM_BIOS_DATA
          MOV         BX,ROM_BIOS_DATA
          MOV         DS,BX
          MOV         SI,BUFFER_TAIL
          MOV         BX,ROM_BUFFER_HEAD          ;Check if real character in buffer
          ADD         BX,2                        ;Skip over dummy character
          CMP         BX,OFFSET KB_BUFFER_END
          JB          DONT_WRAP                   ;No need to wrap the pointer
          MOV         BX,OFFSET KB_BUFFER         ;Wrap the pointer
DONT_WRAP:
          CMP         BX,ROM_BUFFER_TAIL          ;Is there a real character?
          JE          NO_NEW_CHARACTERS           ;No, then return to caller
          MOV         AX,[BX]                     ;Yes, move character to internal buffer
          MOV         CS:[SI],AX
          ADD         SI,2                        ;Move to next position
          CMP         SI,OFFSET KEYBOARD_BUFFER_END
          JB          NOT_AT_END
          MOV         SI,OFFSET KEYBOARD_BUFFER
NOT_AT_END:
          CMP         SI,BUFFER_HEAD              ;Buffer overrun?
          JNE         WRITE_TO_BUFFER             ;Yes, beep and throw out character
          CALL        ERROR_BEEP
          JMP         SHORT NOT_AT_KB_END
WRITE_TO_BUFFER:
          MOV         BUFFER_TAIL,SI
```

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```
NOT_AT_KB_END:
            MOV         ROM_BUFFER_HEAD,BX

NO_NEW_CHARACTERS:
;-----      See if CTRL + ALT pushed, and clear buffer if so

            MOV         AL,KBD_FLAG                 ;Get status of shift keys into AL
            AND         AL,0CH                      ;Isolate Alt and Ctrl shift flags
            CMP         AL,0CH                      ;Are both the Ctrl and Alt keys down?
            JNE         DONT_CLEAR_BUFFER           ;No, then don't clear the buffer
            MOV         AX,BUFFER_TAIL              ;Yes, then clear the buffer
            MOV         BUFFER_HEAD,AX

DONT_CLEAR_BUFFER:
            POP         AX
            POP         BX
            POP         SI
            POP         DS
            IRET
INTERCEPT_KEYBOARD_INT  ENDP

;-------------------------------------------------------------------------------;
;This procedure replaces the ROM BIOS routines for reading a character          ;
;-------------------------------------------------------------------------------;
            ASSUME      DS:CODE_SEG
INTERCEPT_KEYBOARD_IO   PROC        FAR
            STI                                     ; Interrupts back on
            PUSH        DS                          ; Save current DS
            PUSH        BX                          ; Save BX temporarily
            CALL        CHECK_CLEAR_BUFFER          ;Check for buffer cleared
            MOV         BX,CS                       ;Establish pointer to data area
            MOV         DS,BX
            OR          AH,AH                       ;AH=0?
            JZ          READ_CHARACTER              ;Yes, read a character
            DEC         AH                          ; AH=1?
            JZ          READ_STATUS                 ;Yes, return the status
            DEC         AH                          ; AH=2?
            JZ          READ_SHIFT_STATUS           ;Yes, return the shift status
            POP         BX                          ;Ignore other function numbers
            POP         DS
            IRET

;-----      Read the key

READ_CHARACTER:                                     ;ASCII read
            STI                                     ; Interrupts back on during loop
            NOP                                     ; Allow an interrupt to occur
            CLI                                     ; Interrupts back off
            MOV         BX,BUFFER_HEAD              ; Get pointer to head of buffer
            CMP         BX,BUFFER_TAIL              ; Test end of buffer
            JE          READ_CHARACTER              ; Loop until something in buffer
            MOV         AX,[BX]                     ; Get scan code and ASCII code
            ADD         BX,2                        ; Move to next word in buffer
            CMP         BX,OFFSET KEYBOARD_BUFFER_END ; At end of buffer?
            JNE         SAVE_POINTER                ; No, continue
            MOV         BX,OFFSET KEYBOARD_BUFFER     ; Yes, reset to buffer start
SAVE_POINTER:
            MOV         BUFFER_HEAD,BX              ; Store value in variable
            POP         BX
            POP         DS
            IRET                                    ; Return to caller
;-----      ASCII status

READ_STATUS:
            CLI                                     ; Interrupts off
            MOV         BX,BUFFER_HEAD              ; Get head pointer
            CMP         BX,BUFFER_TAIL              ; If equal (ZF = 1) then nothing there
            MOV         AX,[BX]
            STI                                     ; Interrupts back on
            POP         BX                          ; Recover registers
            POP         DS
            RET         2                           ; Throw away flags

READ_SHIFT_STATUS:
            JMP         ROM_KEYBOARD_IO             ;Let ROM routines do this.
INTERCEPT_KEYBOARD_IO   ENDP

;-------------------------------------------------------------------------------;
;This procedure initializes the interrupt vectors.                              ;
;-------------------------------------------------------------------------------;
INIT_VECTORS            PROC        NEAR
            ASSUME      DS:VECTORS
            PUSH        DS                          ;Save old Data Segment
            MOV         AX,VECTORS                  ;Set up the data segment for vectors
            MOV         DS,AX
            CLI                                     ;Don't allow interrupts
            MOV         AX,KEYBOARD_INT_VECTOR      ;Save addresses of BIOS routines
            MOV         ROM_KEYBOARD_INT,AX
            MOV         AX,KEYBOARD_INT_VECTOR[2]
            MOV         ROM_KEYBOARD_INT[2],AX
                                                    ;Set up new KEYBOARD_INT vector
            MOV         KEYBOARD_INT_VECTOR, OFFSET INTERCEPT_KEYBOARD_INT
            MOV         KEYBOARD_INT_VECTOR[2],CS
            STI                                     ;Allow interrupts again
                                                    ;Set up KEYBOARD_IO vector
            MOV         AX,KEYBOARD_IO_VECTOR
            MOV         ROM_KEYBOARD_IO,AX
            MOV         AX,KEYBOARD_IO_VECTOR[2]
            MOV         ROM_KEYBOARD_IO[2],AX
            MOV         KEYBOARD_IO_VECTOR, OFFSET INTERCEPT_KEYBOARD_IO
            MOV         KEYBOARD_IO_VECTOR[2],CS
                                                    ;Now set  up the keyboard buffer, etc.

            ASSUME      DS:ROM_BIOS_DATA
            MOV         AX,ROM_BIOS_DATA
            MOV         DS,AX
            CLI                                     ;Don't allow interrupts now
            MOV         BX,OFFSET KB_BUFFER
            MOV         ROM_BUFFER_HEAD,BX
            MOV         WORD PTR [BX],0
            ADD         BX,2
            MOV         ROM_BUFFER_TAIL,BX
            STI                                     ;Allow interrupts again

            MOV         DX,OFFSET INIT_VECTORS      ;End of resident portion
            INT         27H                         ;Terminate but stay resident
INIT_VECTORS            ENDP

CODE_SEG                ENDS

            END         BEGIN
```

Listing 2.

```
DATA_SEG                SEGMENT AT 40H
            ORG         17H
KB_FLAG                 DB          ?               ;Status flags for shift keys, etc.
DATA_SEG                ENDS

            ASSUME      CS:CODE_SEG, DS:DATA_SEG
CODE_SEG                SEGMENT
BEGIN       PROC        NEAR
            MOV         AX,DATA_SEG
            MOV         DS,AX
AGAIN:      TEST        KB_FLAG,1                   ;Right shift key pressed?
            JZ          AGAIN                       ;No, keep looking
            INT         20H
BEGIN       ENDP
CODE_SEG                ENDS
            END         BEGIN
```

Listing 3. ▲

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MICRO FINANCE

by Ken Landis and Douglas J. Weber

Real Estate Analysis Package (REAP)

Two months ago, we examined the cash flow and tax effects of using a mortgage to buy a house as a principal residence. We also considered the potential benefits and drawbacks of such a scheme. This month, we'll learn how to use a software package to analyze an investment property deal. The software is the *Real Estate Analysis Package (REAP)*, from Execuware, a division of Aeronca, Inc. (7415 Pineville-Matthews Road, Suite 300, Box 100, Charlotte, NC 28226; 704-541-1199 . *REAP* is priced at $149.95.

This month's hypothetical problem comes directly from the *REAP* documentation. It is typical of "real world" investment property decisions, and it provides a good framework in which to learn.

A group of investors—we'll call them SMF Associates—is considering the purchase of an office complex. To fund this $1,100,000 purchase, the investors have arranged for two self-amortizing conventional loans totaling $900,000 and equity contributions of $200,000. The principal amount of the first loan is $750,000. This loan carries a 15 percent interest rate for a term of forty years. The principal amount of the second loan is $150,000, the interest rate is 18 percent, and the term is ten years.

SMF Associates wants to analyze the property's potential as an investment. Profitability will be determined not only by the financing the partners have arranged, but also by the operating characteristics of the property itself. Let's walk through the steps involved in analyzing this investment decision using *REAP*.

IF SMF buys the property, the group may find that capital improvements to make the property more commercially attractive are necessary. And any capital improvements will have to be added to the property's purchase price in order to arrive at the property's initial basis.

For purposes of our example, we'll assume that the SMF property does not require any capital improvements. Therefore, its adjusted cost basis is the same as its purchase price, which means that SMF does not have to consider the immediate impact of any additional financing.

Now that we know what the property costs, we need to know the exact terms of the loan agreements. *REAP* can analyze up to three different loans on a given piece of property.

The first loan can be either a self-amortizing conventional loan or a non-self-amortizing loan. Self-amortizing loan payments consist of both principal and interest (home mortgage loans are typically self-amortizing loans). Non-self-amortizing loans consist solely of interest payments. The principal is paid off separately, usually in one or more balloon payments.

In *REAP*, the second and third loans may be either interest-only loans or switched loans. Switched loans start out as interest-only (non-self-amortizing) and switch to interest and principal payments at a later date. If a balloon payment is due when the note switches, *REAP* calculates the amount due automatically.

REAP can also handle assumable loans. An assumable loan is originally made to the seller but upon the sale of the property becomes the responsibility of the buyer. A buyer will normally assume this type of loan when the loan the seller holds is more attractive (in terms of interest rate, repayment period, covenants, and so on) than a loan the buyer could obtain.

Loan 1 for the SMF Associates property deal is a self-amortizing loan, and loan 2 is a switched loan. This second loan switches at the sixtieth payment, at which point a balloon payment is due.

REAP can allocate interest expense based on the "rule of 78s" method. The "rule of 78s" allocates interest expense according to the sum-of-the-years digits method. The effect of this method of interest allocation is an acceleration of interest deductions in the earlier years of the loan, which provides the investor with a greater immediate tax benefit. Remember your basic finance: A dollar today is worth more than a dollar tomorrow.

In the SMF example, we will be using the rule of 78s for loan 2 but not for loan 1. (Note: As a result of recent tax legislation, the benefits of this method of interest acceleration are substantially different from what they once were. For a complete explanation of the changes, ask your tax adviser about Revenue Ruling 83-84 and Revenue Procedure 83-40.)

At this point, we have entered all the loan information *REAP* requires to perform its analysis. The next series of questions *REAP* asks us concern the operating characteristics of the property; we must estimate the property's gross scheduled income.

Gross scheduled income is the maximum amount of income that a property is capable of producing. Historical information can be used in the estimate, or the investors can estimate the future potential of the property on the basis of current or expected market conditions, the uses for the property, and the competitive environment.

The gross scheduled income potential for a property is not static; it can easily change from year to year. *REAP* allows the investor to enter the beginning expected gross income and up to four additional scheduled incomes, along with what year they become effective. Each year's expected gross income automatically increases by the investor-supplied growth rate, unless this variable income feature is used. For each year in which a new gross income figure is entered, the growth factor is superseded by this amount.

In the SMF example, the gross scheduled income is estimated to be:

Year	Amount
1	$300,000
3	325,000
5	350,000
10	400,000

REAP uses these scheduled gross incomes for each respective year listed. For each of the years 2, 4, and 6 through 9, the gross scheduled income will be an amount equal to the pre-

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Mr. Landis's coauthor this month, Douglas J. Weber, is a tax manager in the Saint Louis office of Peat Marwick.

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vious year's gross scheduled income plus the investor-supplied growth rate. In our example, SMF assumes a 9 percent growth rate; therefore, we should expect to see a gross income of $354,250 for year 4, representing year 3's gross income of $325,000 plus the additional 9 percent growth potential of $29,250.

The difference between the gross scheduled income and the actual income produced by a property is represented by the vacancy factor. This percentage demonstrates that many properties are *not* fully leased or rented 100 percent of the time. The vacancy factor is expressed as a percentage of the yearly gross scheduled income. For example, if, on the average, one-tenth of the SMF property was not producing income, the vacancy factor would be 10 percent.

REAP allows you to change the vacancy factor assumption up to four times, much the same way gross scheduled income may be changed, giving the analysis the benefit of up to five different vacancy factors. The vacancy factor assumption is not adjusted by the investor-supplied growth rate.

The vacancy factor assumption for the SMF deal is 8 percent for the first year through the fourth, 6 percent for years 5 through 9, and 10 percent for year 10 on.

Operating expenses are the costs involved in operating and owning a property. These include such items as taxes, maintenance, insurance, and so on. *REAP* will increase the operating expenses each year in keeping with the investor-supplied growth rate, or the investor can insert up to four new amounts at any point within the investment's time analysis boundary.

The operating expenses for the SMF deal are set up at $87,500 for the first year and $200,000 for the fifth year. In each of the other years, the previous year's amount will automatically increase by the growth rate factor (9 percent).

Now let's consider depreciation, a word that brings joy to the hearts of countless real estate investors. In some cases, depreciation benefits are the sole reason an investor buys real estate. Most of the tax benefits are created by the deductions resulting from depreciation, interest, and miscellaneous other expenses that the investor incurs to carry the property.

Accelerated Cost Recovery System (ACRS), a new method of computing depreciation, is probably the most valuable tax advantage. ACRS provides that for most real property (new or used) placed in service after 1980, deductions that approximate the use of the 175 percent declining balance method of depreciation may be taken over a fifteen-year period. A real estate investor is entitled to use the Accelerated Cost Recovery System or to elect an alternative straight-line method over a period of fifteen, thirty-five, or forty-five years. Investors should look at their particular tax situations and then discuss with their tax advisers the benefits or disadvantages of selecting either the accelerated or the straight-line method.

ACRS applies to both real property and personal property. *REAP* is designed to handle depreciation on both. This software uses ACRS in computing the appropriate recovery deductions (depreciation) for each of these classes of property. The ACRS depreciation methods programmed into the software are ACRS real property, ACRS (1981—1984), ACRS (1985), ACRS (1986 and beyond), and ACRS straight-line.

The SMF real property amount to be depreciated is $800,000 over fifteen years. Although real property includes all buildings and land, it's important to realize that land is not a depreciable asset. The investors had to deduct the market value of the land from the total value of the real property; otherwise they would probably find themselves tongue-tied when they tried to explain their deductions to an Internal Revenue Service agent. (We all know how understanding they can be.)

In this case, the land was valued at $100,000. The personal property amount is $200,000 and is being depreciated over five years. Personal property is primarily property that is not considered real property (for example, equipment, furniture and fixtures, appliances, and so on). Since the ACRS deductions represent cost recovery of various assets, the total of all deductions taken cannot exceed the original purchase price of those assets.

REAP now prompts us to enter the assumed growth rate. *REAP* uses the growth rate to adjust revenue and cost increases that are attributable to inflation. As an investor, you should supply a number that you feel is realistic. Do not rely only on one estimate of future inflation. One very good strategy is to collect the opinions of several economists and research firms and then calculate a weighted average. (Note: This information can be obtained from various trade and professional publications as well as from the news media.) The weights should be based on each predictor's past accuracy.

For the SMF example, we're assuming an inflation, or growth, rate of 9 percent.

REAP now prompts us to supply the investor's tax bracket and up to ten different capital improvement reserves for the property. Reserves are funds that have been set aside to pay for planned or unplanned improvements. These reserves can either cover the entire cost of the improvement or only part of it. We are structuring the SMF property deal with no re-

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serve fund and assuming that the investors in the SMF Associates deal are in the 50 percent bracket.

Next, *REAP* asks for the number of months remaining in the present year after the property is purchased and placed in use. Next, the program asks for the total number of years for which it should calculate projections (twenty is the maximum here). In our example, the property will be in service for six months of the year after it has been purchased. The future period we wish to project is ten years.

Finally, *REAP* asks if the property being analyzed is residential or nonresidential. If the property is residential, *REAP* automatically accounts for the special treatment allowed under present tax law for computing capital gain upon disposition. Disposition includes not only sales but also other forms of transactions, such as (but not limited to) trades or conversions. Gain on the resale of residential property is afforded special treatment under present tax law, depending on the method of depreciation selected. If an investor chooses to depreciate the real property (buildings and related improvements) on a fifteen-year straight-line basis, any gain attributable to these assets is capital gain. However, an investor who chooses the ACRS rapid depreciation option discussed earlier must calculate the excess depreciation taken up to the point of resale and treat this much of the gain as ordinary gain. The result—the excess depreciation can result in a portion of the gain being taxed at an effective maximum rate of 50 percent instead of 20 percent.

Gain on the resale of nonresidential property can still receive preferential treatment, but the rules are somewhat different. If the investor chooses fifteen-year straight-line depreciation for real property, any gain on resale is capital gain. However, election of ACRS results in ordinary gain on resale to the extent of all depreciation taken. When dealing with nonresidential property, the investor must decide whether the benefit to be derived from accelerating the recovery of deductions is expected to outweigh the portion of the gain that will be taxed as ordinary income rather than as capital gain.

These rules apply only to real property. Personal property depreciation, regardless of the option chosen, results in ordinary gain upon resale. Because of the technical nature and complexity of these rules, it's vital that you consult your tax adviser.

We have now gathered all the information we need and have entered it into the program. At this point, *REAP* is ready to do its analysis and produce a report on the investment. The analysis is begun by means of a few simple keystrokes. When the analysis is complete, the report is printed on either an 80- or a 132-column printer.

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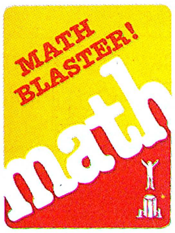

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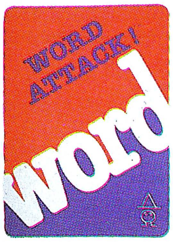

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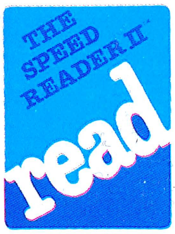

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The *REAP* report for the SMF property, located at 2323 Keener Lane, Charlotte, North Carolina, is shown in the chart on page 133.

The first section, labeled "beginning of year values," displays amounts we entered into *REAP* for purchase price, loan balances, and the adjusted cost basis of the property. The only computed amount in this section is the cash invested, which is the difference between the purchase price and the total loan balance.

The "property income analysis" takes the gross scheduled income for the year and subtracts from it the dollar cost of the vacancy factor. The result is the gross operating income of the property. When the operating expenses for the property are deducted, the pretax net operating income or loss is computed. The capitalization rate is computed by dividing the current year's net operating income by the assumed market value, which is called the purchase price, on line 1 of the report.

With this design, you must be aware that the program is computing the capitalization rate assuming the new purchase price, or market value, which has increased in accordance with the growth rate. Thus this calculation is representative only of a year-by-year analysis.

Taxable income is the income or loss subject to income taxes. A property does not have to have any taxable income to be a moneymaker for the owners. How is this possible? Well, in real estate transactions, the key to a profitable investment lies heavily in the future appreciation of the property, as opposed to current cash flow or net income. Current tax benefits may also be derived from the numerous deductions allowed with real estate investments.

Taxable income is calculated by taking the net operating income of the property and reducing it by calculated interest paid on the outstanding loans and by depreciation (a noncash deduction) on the property. (Note: Even though we invested only $200,000 in cash, we are depreciating the entire depreciable basis [$1,000,000] of the property [excluding land] and receiving a current deduction against the net operating income of $78,000 for only six months of operation.)

Cash flow shows the investors the cash inflows and outflows of the investment. If a property has positive cash flow, the investors more likely than not do not need to inject cash to sustain the property's operation. If it has continuous negative cash flow, the investors will eventually have to make up the deficit to stop the property from going under.

The major components of the "cash flow" section are *gross spendable, income tax benefits,* and *reserves.* Gross spendable represents the excess or deficit cash received from operations over and above the expenditures relating to principal and interest payments—that is, cash outflows. Income tax benefits are gained if the property creates negative taxable income. A taxable loss provides a tax benefit equal to the loss multiplied by the investor's marginal income tax rate. It is very likely that you can receive a tax benefit at the same time you have positive cash flow. The reserve represents any monies that were earmarked for potential future capital improvements. These reserves are added to the reserve account balance each year until expended.

The net cash flow shows the amount of money from the current period available for distribution to investors. Cash flow is different from income in that it represents dollars as they physically move, rather than dollars that are "accounted" for, which include both cash and noncash transactions. The present year's cash flow is added to all previous cash flow; the result of this addition is the cumulative cash flow for the property. Cumulative cash flow shows the total amount of money that has passed through (or, in the case of negative cash flow, has been taken out of) the till. In essence, it is the true layman's "income" on the property.

REAP produces certain ratios that are designed to be "key indicators" of a property's

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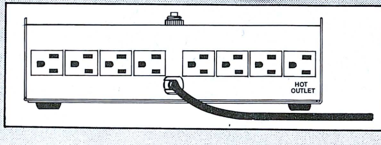

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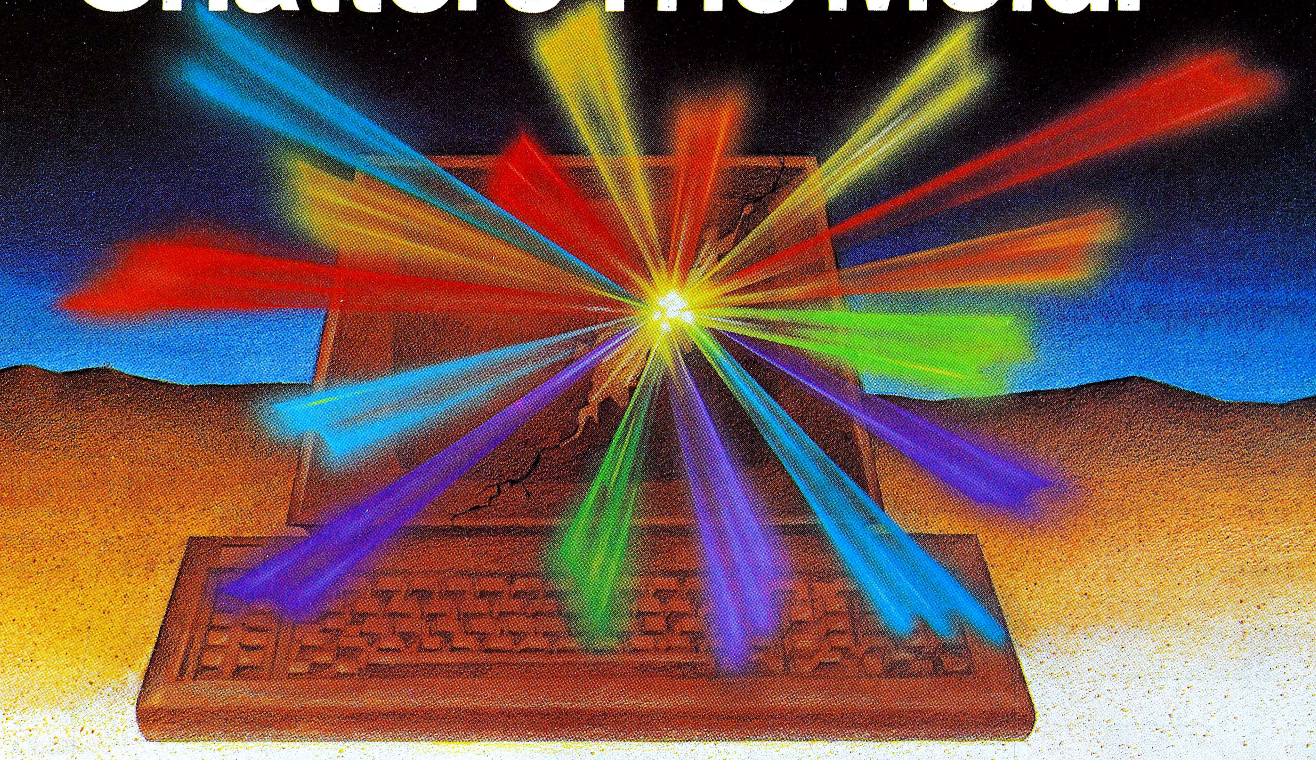

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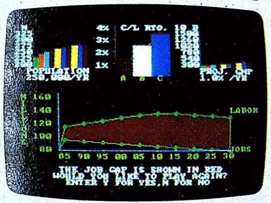

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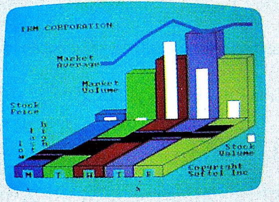

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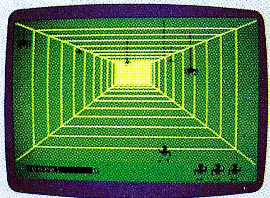

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performance. As an investor, you must determine which of these ratios are important to you.

Net cash return on equity is the net cash flow for the year, divided by the total cash invested. It represents the cash flow return to investors on their equity (ownership). The *net cash return on investment* is the result of the present year's cash flow divided by the original investment in the property. Using this rate of return, investors can determine if the property is the best current investment. If another investment appears as though it will yield a higher return, investors should consider "redeploying" their assets.

The equity income section shows us how the property has performed during the present year. *Net spendable income* is the same as the net cash flow, shown in the previous section. When this figure is adjusted by principal payments—either principal reductions or increases, which are determined by the characteristics of the loan—the result is *net equity income.*

The *net return on investment* is computed by dividing net equity income by the original investment. The *net equity income rate* is computed by dividing the current year net equity income by the total cash invested in the property. This result represents the rate at which the current year's equity income is expressed as a percentage of the total cash invested to date. (Note: This differs from the previous calculation in that it uses total cash invested, as opposed to the original cash invested.)

The *equity growth rate* is computed by taking the incremental increase in value of the property (as shown on line 40) and dividing it by total cash invested (line 6). This computation takes into account the noncash appreciated value of the property, expressed as a percentage of the total cash invested. The *total equity rate* is simply the sum of the previously determined net equity income rate (line 33) and the equity growth rate (line 34). This ratio produces the total equity rate by combining the equity derived via current equity income with the appreciated value of the property.

The depreciation section shows the current year's depreciation broken down between real and personal property. This represents the amount that has been deducted based on the ACRS methods chosen during data entry.

The summary is just that. It starts out with net equity income (line 39) and increases this amount by the *current year's computed appreciated value* (line 40) based on the investor-supplied growth rate. The combination of these two amounts represents the *total gain on the property* for the year (line 41). The ratio calculated on line 42 is the total gain expressed as a percentage of the original investment.

The "results of sale or exchange at year end" section provides information on the overall tax and equity effects that would result if the property were sold or exchanged at year end. This section is designed to take into account the results produced from all the previous calculations, combined with current tax law (which must be updated to reflect changes) and other investor-supplied data, to produce the information supplied in lines 43 through 54. It can "tempt" an investor to sell, or it can promote the idea of holding onto the property.

How do you know whether to hold or sell a property? *REAP* won't tell you what to do, and we won't try to either. Investments are very personal matters, and the results of a sale or exchange of real estate or investment property can have very complex tax and legal ramifications. For these reasons, you really should discuss any moves with tax and legal experts.

So what has *REAP* done for us? Primarily, it has forced us to structure our analysis. It will not let us forget about an important assumption or variable. No matter how structured an analysis is, however, or how often *REAP* prompts you to enter data, the program's analysis will only be as good as the data you enter. Remember the old data processing adage: GIGO (garbage in, garbage out). In other words, if you are not realistic, *REAP* will not be realistic either.

One of the major strengths of the software is that it allows an investor to analyze many different sets of alternatives quickly and easily. Naturally, the higher the quality of information on which you base your decision, the better that decision will be.

The documentation that comes with *REAP* is clear and easy to read. However, it is designed for the expert real estate investor. The program makes no effort whatsoever to explain either how the analysis is run or how it should be interpreted. The interpretations in this article are the authors', and you should be aware that it took many hours of banging on a calculator to figure out how various computations were made. This was necessary, because *REAP*'s documentation does not show the user what formulas are used in the program. To add validity to its results, any analytical tool really should be fully documented in this area.

In its current form, without sufficient written backup information about its calculations and terminology, or explanations of what the numbers mean, *REAP* will probably be of value only to sophisticated real estate investors or marketeers. If you don't fancy yourself as a world-class real estate investor, you're likely to find *REAP* easy to operate but difficult to interpret. (Chart follows on page 133.) ▲

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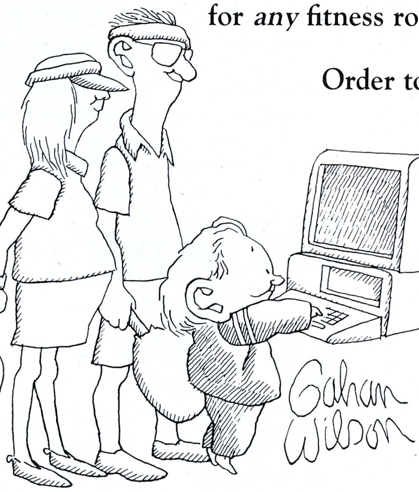

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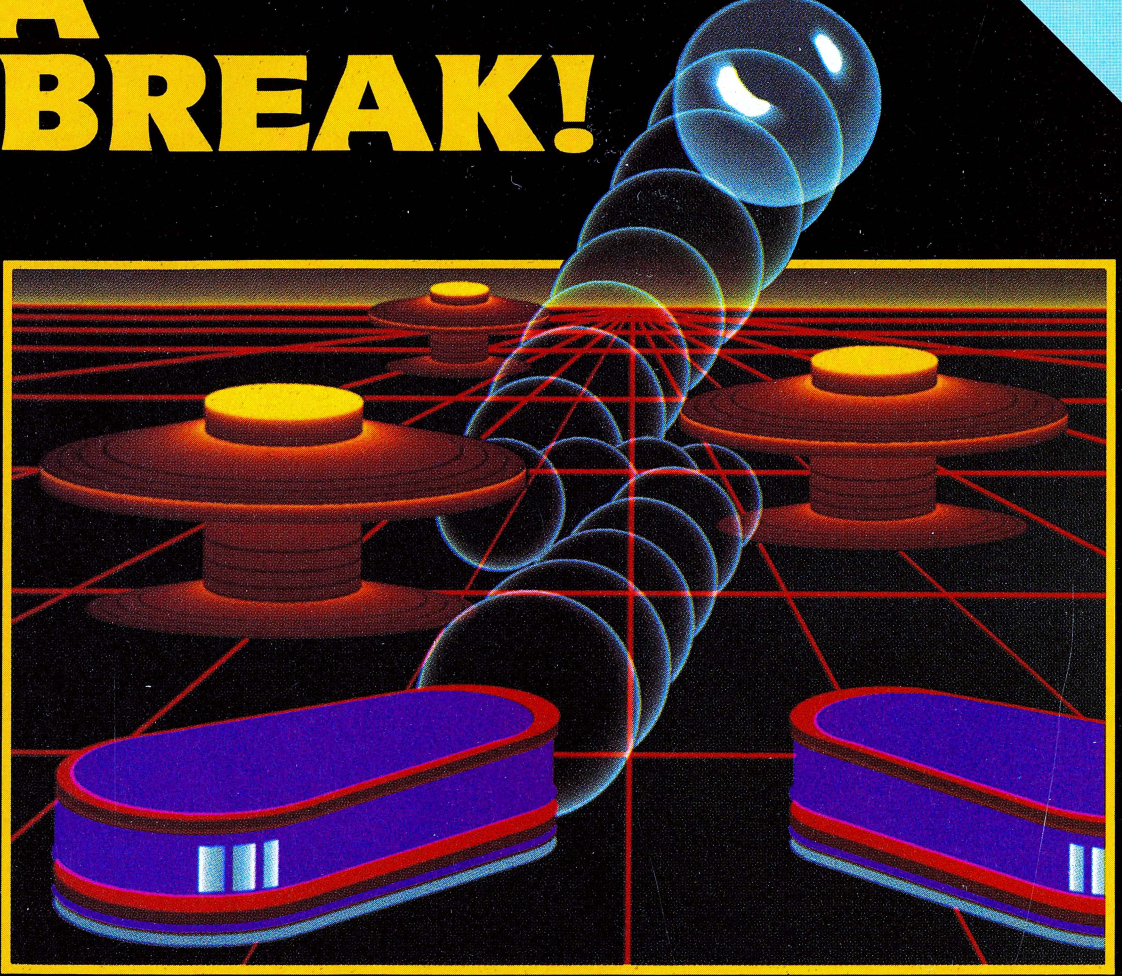

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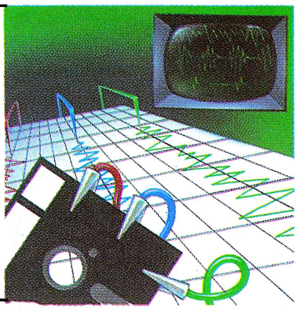
BEGINNING OF YEAR VALUES	1	2	3	4	5	6	7	8	9	10
1 Purchase Price	1100000	1149500	1252955	1365721	1488636	1622613	1768648	1927826	2101330	2290450
2 Loan 1	750000	749850	749515	749126	748675	748151	747543	746837	746018	745067
3 Loan 2	150000	161951	177885	183197	177886	161952	0	0	0	0
4 Loan 3	0	0	0	0	0	0	0	0	0	0
5 Total Loan Balance	900000	911801	927400	932323	926561	910103	747543	746837	746018	745067
6 Cash Invested	200000	237699	325555	433398	562075	712510	1021105	1180989	1355312	1545383
7 Adjusted Cost Basis	1100000	1022000	890000	768000	654000	548000	492000	444000	404000	364000
PROPERTY INCOME ANALYSIS										
8 Gross Scheduled Income	150000	313500	325000	354250	350000	381500	415835	453260	494053	400000
9 Less Vacancy Factor	12000	25080	26000	28340	21000	22890	24950	27196	29643	40000
10 Gross Operating Income	138000	288420	299000	325910	329000	358610	390885	426064	464410	360000
11 Less Operating Expenses	87500	182875	199334	217274	200000	218000	237620	259006	282317	307726
12 Net Operating Income	50500	105545	99666	108636	129000	140610	153265	167058	182093	52274
13 Capitalization Rate	4.59	9.18	7.95	7.95	8.67	8.67	8.67	8.67	8.67	2.28
TAXABLE INCOME										
14 Net Operating Income	50500	105545	99666	108636	129000	140610	153265	167058	182093	52274
15 Less Interest Payments	56245	112455	112401	112339	112266	112182	112084	111971	111839	111686
16 Interest By Rule of 78's	25451	42934	32312	21689	11066	1549	0	0	0	0
17 Less Depreciation	78000	132000	122000	114000	106000	56000	48000	40000	40000	40000
18 Taxable Income	-109196	-181844	-167047	-139392	-100332	-29121	-6819	15087	30254	-99412
CASH FLOW										
19 Net Operating Income	50500	105545	99666	108636	129000	140610	153265	167058	182093	52274
20 Less Principal & Interest Payments	81846	155724	145102	134479	123856	276290	112790	112790	112790	112790
21 Gross Spendable	-31346	-50179	-45436	-25843	5144	-135680	40475	54268	69303	-60516
22 Income Tax Benefit	-54598	-90922	-83523	-69696	-50166	-14560	-3409	7544	15127	-49706
23 Less Reserves Transaction	0	0	0	0	0	0	0	0	0	0
24 Net Cash Flow	23252	40743	38087	43853	55310	-121120	43884	46724	54176	-10810
25 Cumulative Cash Flow	23252	63995	102082	145935	201245	80125	124009	170733	224909	214099
26 Reserve Account Balance	0	0	0	0	0	0	0	0	0	0
27 Net Cash Return on Equity	11.63	17.14	11.70	10.12	9.84	-17.00	4.30	3.96	4.00	-0.70
28 Net Cash Return on Investment	11.63	20.37	19.04	21.93	27.66	-60.56	21.94	23.36	27.09	-5.41
EQUITY INCOME										
29 Net Spendable	23252	40743	38087	43853	55310	-121120	43884	46724	54176	-10810
30 Principal Payments	-11801	-15599	-4922	5763	16458	150608	706	819	951	1104
31 Net Equity Income	11451	25144	33165	49616	71768	29488	44590	47543	55127	-9706
32 Net Return on Investment	5.73	12.57	16.58	24.81	35.88	14.74	22.30	23.77	27.56	-4.85
33 Net Equity Income Rate	5.73	10.58	10.19	11.45	12.77	4.14	4.37	4.03	4.07	-0.63
34 Equity Growth Rate	24.75	43.52	34.64	28.36	23.84	10.25	15.59	14.69	13.95	13.34
35 Total Equity Rate	30.48	54.10	44.83	39.81	36.60	14.39	19.96	18.72	18.02	12.71
DEPRECIATION										
36 Real Property	48000	88000	80000	72000	64000	56000	48000	40000	40000	40000
37 Personal Property	30000	44000	42000	42000	42000	0	0	0	0	0
38 Total Depreciation	78000	132000	122000	114000	106000	56000	48000	40000	40000	40000
SUMMARY										
39 Net Equity Income	11451	25144	33165	49616	71768	29488	44590	47543	55127	-9706
40 Plus Increase in Value Property	49500	103455	112766	122915	133977	73018	159178	173504	189120	206141
41 Total Gain	60951	128599	145931	172531	205745	102506	203768	221047	244247	196435
42 Total Gain as % of Orig. Invest.	30.48	64.30	72.97	86.27	102.87	51.25	101.88	110.52	122.12	98.22
RESULTS OF SALE OR EXCHANGE AT YEAR END										
43 Purchase Price	1149500	1252955	1365721	1488636	1622613	1768648	1927826	2101330	2290450	2496591
44 Less Selling Cost	86213	93972	102429	111648	121696	132649	144587	157600	171784	187244
45 Less Adjusted Cost Basis	1022000	890000	768000	654000	548000	492000	444000	404000	364000	324000
46 Taxable Gain	41287	268983	495292	722988	952917	1143999	1339239	1539730	1754666	1985347
47 Excess Depreciation	48000	136000	216000	288000	352000	408000	456000	496000	536000	576000
48 Depreciation for Recapture	41287	136000	216000	288000	352000	408000	456000	496000	536000	576000
49 Tax on Ordinary Income at Sale	20644	68000	108000	144000	176000	204000	228000	248000	268000	288000
50 Tax on Capital Gain at Sale	0	26597	55858	86998	120183	147200	176648	208746	243733	281869
51 Total Tax at Sale	20644	94597	163858	230998	296183	351200	404648	456746	511733	569869
52 Equity if Sold	130842	136986	167111	219429	294631	537256	631754	740966	861866	995515
53 Equity if Exchanged	237699	325555	433398	562075	712510	1021105	1180989	1355312	1545383	1752628
54 Internal Rate of Return DCF	0.00	0.26	11.85	19.39	24.49	26.27	26.21	26.04	25.82	24.87

marketalk reviews



Unless otherwise indicated, software listed runs in DOS 1.1 or 2.0 with either display adapter and requires 64K and at least one disk drive.

The Creator

Software Technology for Computers bills *The Creator* as a "Basic Program Generator." There're lots of ideas tied up on those few words that need clarification before we come to grips with the program itself.

In the ancient microcomputing era that was BBB (before Big Blue), a British concern made waves at the West Coast Computer Faire with a program called *The Last One.* It too was a Basic program generator, and the good folks from Great Britain hyped it as "the last program you'll ever need to buy."

In essence, what they were alleging was that *The Last One* was capable of writing any application program that you were capable of conceiving. Those with generous spirits labeled that claim "hyperbole." The less generous were. . .well, less generous, using a term generally reserved for waste matter from a bovine male.

As events transpired, the latter group was closer to the mark. If *The Last One* turned out to be the last program you ever bought, it was because you got fed up with computing and turned to needlepoint.

Program generators do indeed write programs, but they have limitations that invalidate any pretentions to being the only program you'll ever need.

Application programs that write application programs are a relatively new development at all levels of computing. On larger systems, they're more flexible than their micro cousins, but all suffer generally from the same deficiency—they allow you to generate only those programs that the author of the program generator provided for. If you want to write a statistical analysis package and the author only provided for database applications, you have arrived at that location most often described as being upstream in a sewage disposal system without means of propulsion.

Most commonly, program generators actually function to create specialized database applications. They normally don't do much else, and they certainly don't do windows.

The word "Basic" has real meaning in the description as well; and whether that word implies a strength or a weakness depends on the individual end user.

In fact, the programs written with *The Creator* and other common microcomputer program generators are executed in Basic. For users demanding high performance, the slowness of execution speed inherent in a Basic program can be frustrating.

But there's another side to that issue. First, the program can be compiled for faster execution. Second, the program in its native form can be easily understood and modified. That modifiability is one of the strengths of a program generator.

The Creator goes a couple of tentative steps beyond producing listable, modifiable code for specific database functions. It also lets you generate your own text editor—called a word processor in the manual—and your own graphing module. And the program performs its functions with simplicity and speed. It generally is true that the greenest novice can write hundreds of lines of bug-free code in a few hours using *The Creator.*

Author Gary Haffer has taken care not to leave the beginner behind. His manual starts with a brief but pithy explanation of Basic programming techniques that will stand the user in good stead as time goes by. He concludes the manual with various helpful tips about the use of the pc that can do nothing but make the owner a better microcomputer user.

And within the guts of the manual itself are clear and concise explanations of how the program works that approach being foolproof. With *The Creator*, you can get a mailing list program in less than thirty minutes and an invoicing program in less than an hour. What you don't get with those programs is peak performance. That's where modification and compiled code enter the picture.

Once *The Creator* has chunked out miles of Basic code, the smart

THE USUAL HOLIDAY DRIVEL IN THE GUISE OF A HOUSE AD

Make no mistake about it: The inexorable sands of time have crept around again to that spot on the calendar we so euphemistically call the "Holiday Season." We get Thanksgiving this month, followed by Christmas, New Year's, and then a chance to catch our breath.

So what are we thankful for? Well, we're thankful *PC* and *PC World* haven't put us out of business yet. And we're thankful that our book division has almost earned its name by getting at least one manuscript almost ready for printing. We're also grateful that one or two of our columnists are actually sending in their copy on time.

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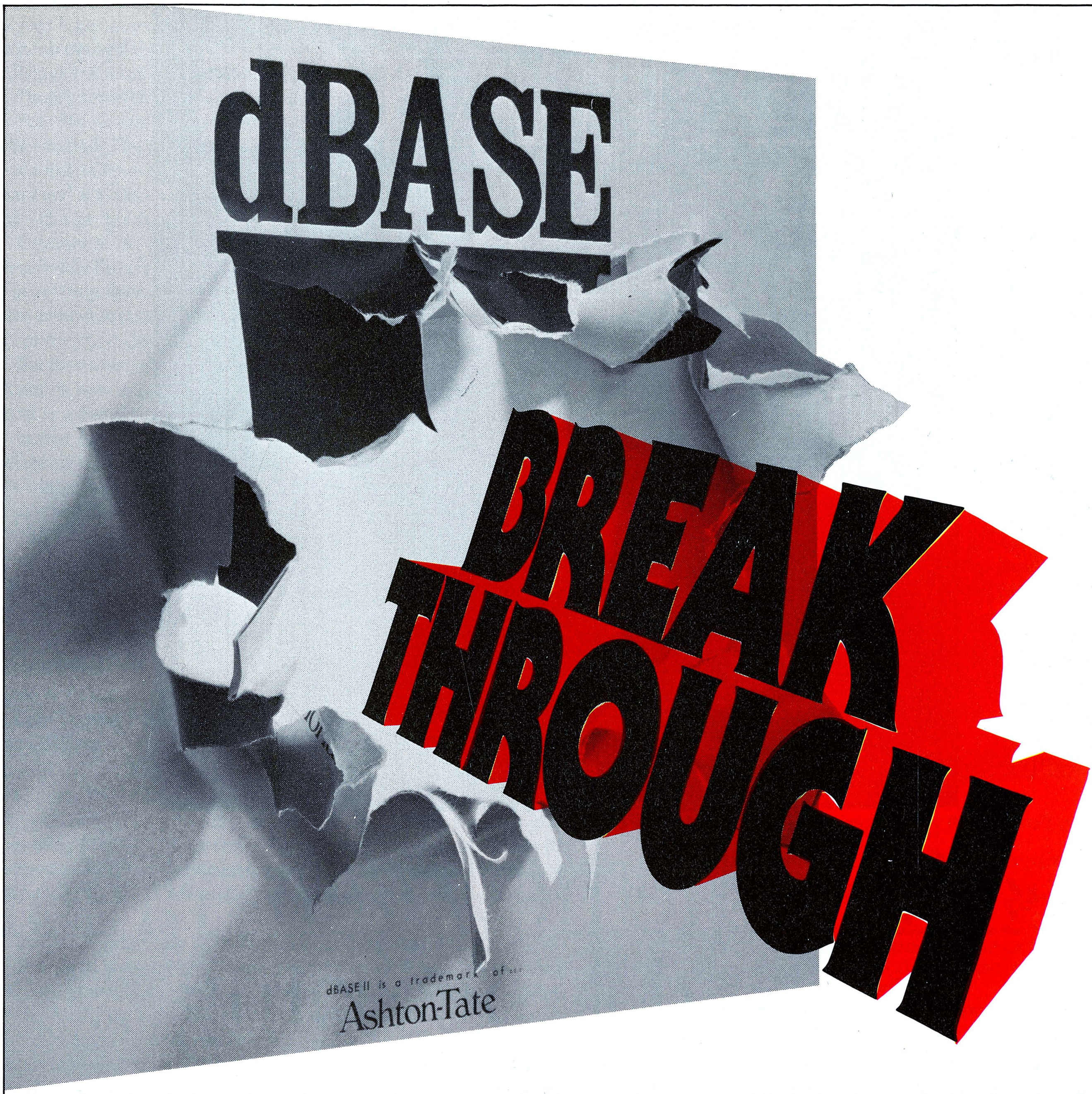

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user will go in and optimize that code for faster execution. The smarter user will then compile the program for even speedier execution. Even then, no one will think they're seing *dBase II* in action. But the program will have the merit of being precisely what you want, when you want it. There's something to be said for that.

For *The Creator* to accomplish its mission, certain niceties have been omitted. There's no attempt at precision screen editing. Each field gets a line of its own. That may be efficient, but it certainly lacks elegance and at times—when it would be helpful to have several fields on a line—can be disconcerting.

Elegance aside, however, program generators have a real place in the software library of all microcomputer users who want the flexibility of generating their own specific applications. A program writer spews forth error-free code in a hurry, leaving the author merely with the task of optimizing it. Just as a labor-saving device, they earn their keep.

But they aren't a replacement for the powerful commercial database programs now appearing on the pc market. They can best be understood as a complement to commercial programs.

In that light, *The Creator* stands up very well, thank you. No one will throw away *dBase II* for the database features or *WordStar* for the text editor. But it's hard to imagine anyone being disappointed with it, unless they thought they were buying their last program. *The Creator* shouldn't be the last program you'll ever buy, but maybe it should be the next one. ART

The Creator, by Gary Haffer, Software Technology for Computers (153 California Street, Newton MA 02158; 617-923-4334). $300. Requires two double-sided disk drives.

MasterType
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Many are the skills that the owner of a personal computer might wish to acquire. You could master Basic or another high-level language and get your pc jumping through hoops. You could learn assembly programming to make it jump faster. Word processing would facilitate the composition of that Gothic romance you've always meant to dash off over a long weekend. Or perhaps you fancy battling trolls in an underground empire.

Before you start any of these, however, you should learn to type.

The days are long past when learning to type was the exclusive province of would-be secretaries. As the computer becomes a window on the world for everyone from corporate executives to elementary school kids, keyboard mastery becomes an important requisite for frustration-free computing. After all, the world's most sophisticated word processor will be to no avail if you laboriously have to hunt and peck the steamy dialogue for your novel. And what about program listings? Man knows no greater drudgery than to input several dozen lines of data statements number by number. And because you must shift your eyes from page to keyboard to screen to page, there's an excellent chance you will make enough typing errors to hang up the whole system the first time you try to run your program. And wouldn't battling trolls be more fun if your fingers flew along the keys at your subconscious command?

For those of us who shunned the junior high school typing class, all is not lost. Several companies have produced typing tutors in an attempt to make it possible for even the most obdurate one-finger hunter and pecker to build speed and confidence. It's possible that even those already initiated into the touch system of typing would want to consider working with one of these programs, whether to increase speed or simply to adjust to the eccentricities of the pc keyboard.

Type-Righter, from Oakes, starts with a display of the keyboard and the option of having all the keys labeled or just the ones you'll be working with. It might be advisable for a beginner to leave the key display off, as otherwise you'll spend as much time trying to spot which key is blinking on your display (the program's prompt for typing) as

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you do learning the keyboard. If you have a graphics adapter, you have the option of watching ghostly hands float over the keyboard and indicate which key you're to strike.

The program offers a series of "lessons" and "exercises" that concentrate on different sections of the keyboard. An evaluation option stops the lesson and informs you of the number of hits and misses as well as the number of strokes per minute that your fingers have been able to manage. Isn't typing speed usually measured in words per minute? Yes, but *Type-Righter* does not actually feature any words; its lessons concentrate on single keys. The program is designed to teach the utter neophyte the layout of the keyboard, so those who wish to brush up on their rusty typing will probably find it inadequate.

Touch Typing Made Easy!, from Alkazar Associates, has a keyboard display similar to that of *Type-Righter.* The exercises provided include typing lists of words and short sentences such as "firs lure dealers." This probably does more to take the budding typist beyond merely learning the layout of the keyboard and toward greater speed and confidence. Just how much greater speed you may never know, as the emphasis in the exercises is on accuracy; speed is not reported. Still, this could be an excellent program for those wishing to brush up dormant typing skills but not planning on becoming typesetters.

Type & Learn, from Simsoft, represents a step up in both sophistication and cost. The authors take the educational aspect of their program very seriously. Practice is provided in typing letters, words, and phrases. What's more, the exercises themselves serve a didactic purpose—students practice typing computer terms and definitions. There are two hundred of these words and definitions in the program's data files, so a serious-minded typist could get plenty of practice. The program provides an evaluation that includes the right-to-wrong ratio and (at the intermediate level) words per minute.

Type & Learn takes a no-nonsense approach to the rote typing instruction drills, and teachers are likely to appreciate the efforts the program's authors have made to ensure that the program can be used in a classroom setting. Younger typists, however, might find the soberness of the program a bit daunting.

MasterType takes a completely different tack. Lightning Software's entrant is essentially an attempt to create a typing arcade game. The user types letters or words at the program's prompting. Each correctly typed word unleashes a blast of energy to destroy one of four creeping aliens that threaten the spaceship in the center of the screen. The game, er, educational program, makes effective use of color and sound to turn the inevitable typing drill into something that, while not exactly *Pac-Man*, is kind of fun.

In addition, *MasterType* lets you choose the typing speed goal that you would like to achieve and provides you with an accuracy and words-per-minute evaluation after each onslaught of aliens. Don't worry, if you set your goal too high, the program gently hints that you try an easier level. Another excellent feature of the program is its ability to recognize words that take the user more than one attempt to type and to repeat these words shortly afterward as a kind of Skinnerian reinforcement.

MasterType is the sort of sugar-coated educational program that kids will love; they can even make their own word lists so they can learn to type the names of, say, their favorite sports stars and zap aliens too.

Of course, most people could probably learn to touch-type simply by learning the home keys and carefully working out which letter should be hit by which finger. Any of these programs, however, will teach your digits to dance much faster than you could do alone. Who knows, you might even find it fun. JB

Type-Righter, by Martin Oakes, Oakes (2100 Oriole Drive, Freeport, IL 61032; 815-235-9131). $19.

Touch Typing Made Easy!, Alkazar Associates (2638 South Lynn Street, Arlington, VA 22202; 202-382-7407). $24.95.

Type & Learn, Simsoft (Box 7095, Port Huron, MI 48301; 313-984-1570). $60.

Master Type, by Bruce Zweig, Lightning Software (480 California Avenue, Palo Alto, CA 94306; 415-327-3280). $49.95. ▲

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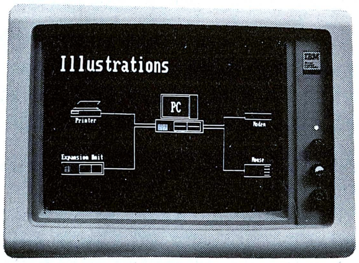

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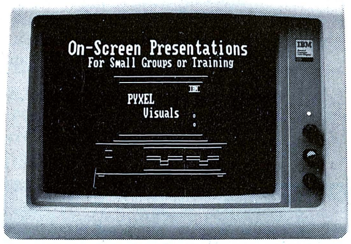

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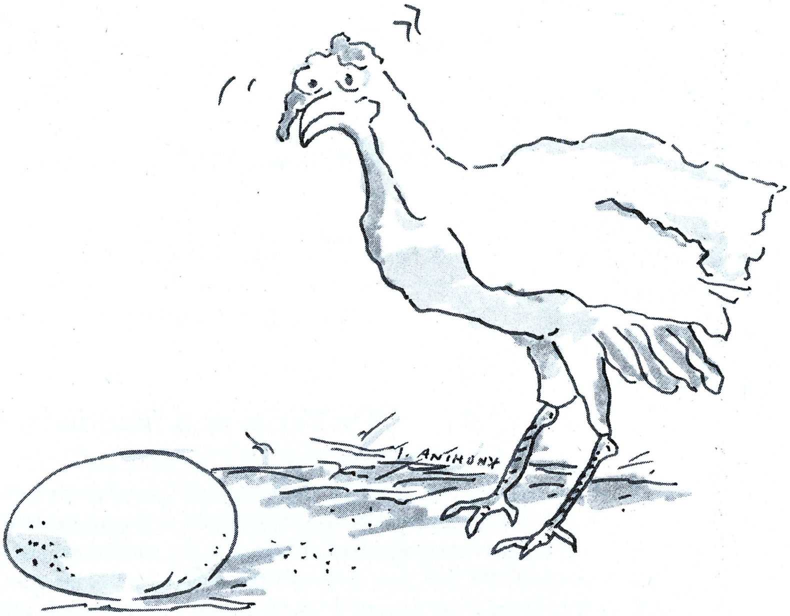

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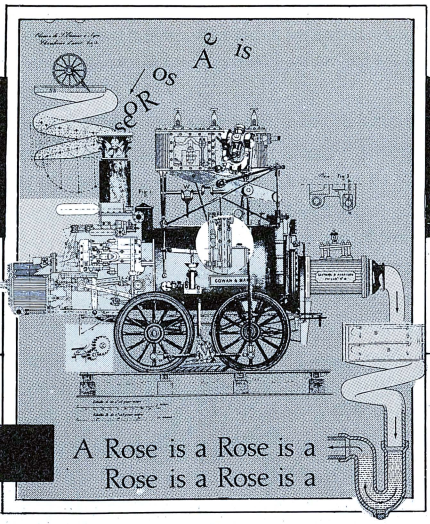
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PFS: Write and MultiMate

This month we'll look at *PFS:Write* and *MultiMate*, two new word processors aimed at vastly differing audiences.

PFS:Write

PFS:Write is the newest member of the PFS family, which also includes *PFS:File, PFS:Report,* and *PFS:Graph.* Software Publishing Corporation's programs have a reputation for being incredibly easy to learn and use, and *Write* is no exception. To keep the program simple, *Write*'s designers have tried to include only the most commonly used features and have purposefully left out some of the frills you'll find in the more powerful (and more expensive) word processing programs. The result is a straightforward program that's both effortless to learn and efficient to use.

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Overall Design. *Write* works as easily as the other PFS programs. All commands are entered through a series of menus, except for the editing operations, which are done with special function keys. Throughout the program you use the F10 key (instead of the enter key) to give the go-ahead after you enter a command, while the escape key puts the brakes on and returns you to the main menu.

Text Entry and Editing. When you select the type/edit submenu from the main menu, the editing screen appears and you're ready to go. Lines at the top and sides of the screen represent the edges of the electronic page; at the bottom are a ruler and a status line. The ruler marks the left and right margin settings, any tab stops that you have set, and the horizontal position of the cursor. The status line displays the name of the document being edited and the line and column coordinates of the cursor. There's also a "gas gauge" that indicates the percentage of memory your document occupies.

When you enter the type/edit menu, the editor is automatically in overtype mode. To insert text, you press the insert key; this mode change is indicated by the cursor, which instantly changes from a blinking underscore to a rectangle.

Although *Write* doesn't give you an overabundance of ways to move the cursor, it doesn't compromise on speed—the cursor covers ground at a gallop. The arrow keys move the cursor a character or a line at a time, and the F3 and F4 keys, combined with the shift key, move the cursor forward and backward word by word and to the left and right margins respectively. The home and end keys take you to the beginning and end of the document.

Unlike some programs that page through your document at a snail's pace, rewriting the screen one line at a time, *Write* displays each new screen almost instantly, even when you move ahead by several screens at once. On the other hand, *Write* doesn't scoll horizontally, so you can't create documents wider than seventy-eight columns. At print time, however, you can merge wider documents, such as spreadsheets, by sending your printer a special code for printing in compressed mode.

Write deletes by character, word, or line. The backspace key deletes the character to the left of the cursor, the delete key removes the character under the cursor, and the F5 and F6 keys delete the word or line that the cursor is on.

You can manipulate larger segments of text with the block editing functions. To mark a segment you want to move or delete, press F5 and move the cursor to the end of the block; the cursor highlights characters as it passes over them. If you mark the wrong block by mistake or change your mind, press F5 again and the highlighting will disappear.

Once you've marked the block, you can remove it simply by pressing delete, if delete is all you want to do. Instead of throwing your text away, *Write* stows it in a temporary buffer where it remains until you replace it with another block, turn the computer off, or indicate where you want the block to go.

This means that in order to move a block you have to delete it first (a very disconcerting procedure), then move the cursor to the new location, and press F6 to retrieve the block from the buffer. The buffer can hold only thirty-five lines at a time; you can't move a larger block. If you try to manipulate more than thirty-five lines, the program cautions you that part of your text will be lost unless you break the block into smaller segments. If you're deleting text, you can ignore the message; if you're moving text to a new location, you'd better heed the warning.

The search and replace functions give you plenty of on-screen help. You begin a search by pressing F7; "Search for:" appears at the bottom of the screen. Type in the word (or phrase)

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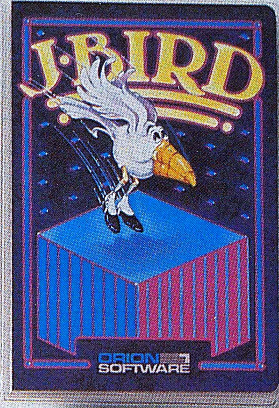

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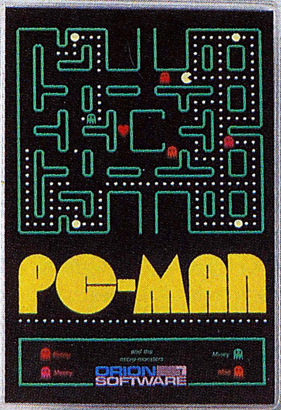

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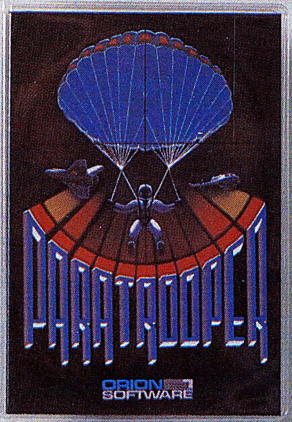

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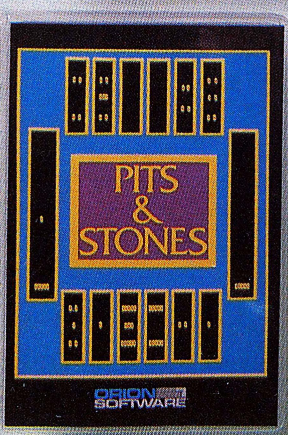

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you want to find, press F10, and *Write* displays the word's first occurrence. Just keep pressing F7, followed by F10, to search for other occurrences.

When searching, *Write* ordinarily looks for whole words (as opposed to words within other words); it also ignores case. You can search for partial words or phrases, such as all words beginning with invest, by attaching two periods to the beginning or end of the word. If you enter *invest..* the words *invest, invests, investment, investor,* and the like will be found. If you want to replace a word (or phrase) with another, you can either review each occurrence individually before giving your okay to the change or ask the program to do an automatic global replacement.

An interesting variation on the search function tells you the total number of words in your document or counts the number of times you've used a particular word or phrase. To get a total word count, type two periods after the "Search for:" prompt. As your document scrolls by, the cursor races furiously through it and the program counts words as it goes.

Among the editing features *Write* doesn't offer are column mode, math capability, and windowing.

Formatting and Printing. *Write*'s excellent on-screen formatting ensures that what you see on-screen almost always corresponds to the printed page. However, the notable exceptions are that the screen shows only single spacing no matter how you have formatted the spacing, and, on color monitors, *Write* designates boldfacing and underlining with color.

Page breaks are shown as a pair of horizontal lines; you can start a new page anywhere in a document by embedding the command **New Page**. By moving the cursor through the define-page menu, you can adjust the margin settings, change the page length, and insert any text that you want to have appear in headers or footers. *Write* won't have page numbers automatically printed; if you want them, you have to insert the starting page number in a footer. Since *Write* assumes that any number it encounters in a footer is a page number, you'll have to be careful about using other numbers in your footers (such as chapter numbers). Headers and footers can be no more than two lines long and they cannot be aligned with the left or right margin (as you may well want to do); the headers and footers are always centered.

Any changes that you make in the format menu will affect your entire document. For example, if you change margin settings when you're on page five, the program will back up to the beginning of your document and quickly adjust the margins to the new values. This means that you can't vary the margins within a document (which you may want to do in an outline, for example) without breaking it down into more than one file.

A feature you might not expect in a program of this price is automatic paragraph reform. You never have to worry about straightening up your paragraphs after you make deletions or insertions or, as we just mentioned, after you change the margins. In fact, the text snaps back into shape so quickly that you won't even notice that it's being reformed.

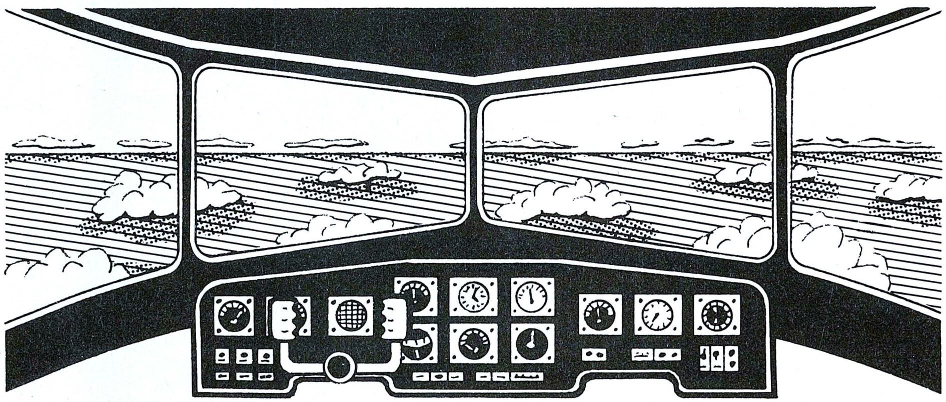
Write handles other simple formatting functions like a pro. You set tab stops by pressing F2 and positioning the cursor at the appropriate column on the ruler. You indicate whether you want a regular typewriter tab or a decimal tab by typing either a T or D respectively. You can center-, left-, or right-justify individual lines of text by pressing F8, followed by C, L, or R.

You will not find it so easy to gain access to your printer's special features, on the other hand. Although you boldface and underline text by just pressing F7 or F8, other printing enhancements, such as overstrike and super- and subscripts, require you to send ASCII control codes to your printer. You'll have to consult your printer's manual to see which codes the printer accepts.

If you need formatting capabilities beyond the basic functions, you'll definitely want a more powerful program. For example, *Write* won't help you with hyphenation or allow you to produce fully justified or proportionally spaced text. It also won't set up temporary margins for typing indented text, nor will it do automatic footnoting.

File Handling. *Write* keeps your entire document in memory, as opposed to writing parts of it to disk, so the maximum file size is about sixteen double-spaced pages. Once your document reaches this size you have to save it to disk and continue editing in a new file. This isn't really much of a disadvantage, however, because *Write* makes it very easy to join two or more files together at print time. By embedding the command **Joinfilename** at the end of each file, you can indicate which file you want printed and wedded with the previous file.

This handy file-joining feature makes it easy for you to merge files from programs other than *Write*. For example, you can add a report produced by *PFS:Report* or a graph from *PFS:Graph*. You can even insert a *VisiCalc* worksheet or a document you produced with another word processing program. The only limitations are that all nonstandard files be converted to standard ASCII files and that wide documents be printed in compressed mode.



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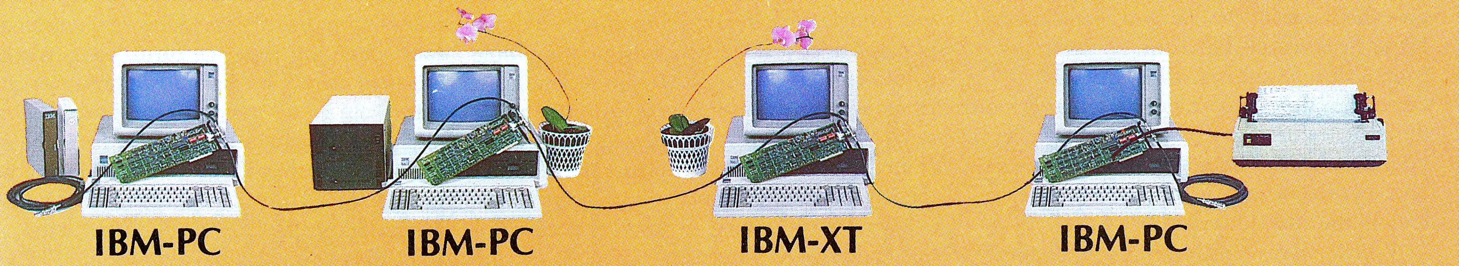

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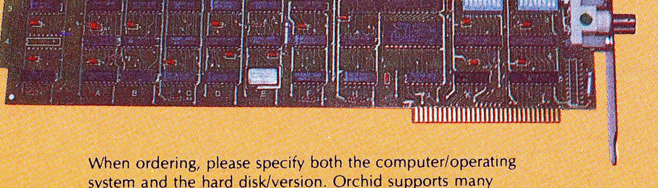

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When you're ready to print your document you call the print menu to define how you want the printing done. By changing the values in this menu you can indicate whether you want single or double spacing, specify a range of pages to be printed, and even print multiple copies of your document. If you're printing a letter, you can have an envelope printed at the same time. The program extracts the address from the letter (it looks at the first line of text at the left margin), prompts you to insert an envelope into the printer, and automatically centers and prints the address.

The final option in the print menu allows you to merge data from *PFS:File* with documents in *Write* to produce form letters. *Write* makes an ordinarily tricky process amazingly easy. First you type the form letter, placing identifier names from *PFS:File* wherever you want data to be inserted—for example, you might want to place an identifier from the address slot so that *Write* can read in the addresses of all the fly-fishermen in Duluth, Minnesota, from *PFS:File* into your letter. At print time you enter the appropriate *PFS:File* filename in the print menu and insert the disk containing that file. *Write* automatically does the printing without having to make use of the *PFS:File* program disk.

Ease of Learning and Use. *Write* combines friendliness and ease of use with efficiency. Software Publishing Corporation has done a superb job of providing plenty of on-screen help without letting the assistance get in your way. Although you can call a help screen from anywhere in the program, the menu choices are so logical that you'll seldom need assistance. If you do get into a dangerous situation, such as forgetting to save one document before starting another, *Write* displays a warning message that clearly explains the problem. All this is done in a low-key manner, without annoying sound effects or flashing screens.

Even after you're an expert with the program (which is to say after about fifteen minutes), the menu system won't slow you down. Since most of *Write*'s editing functions are handled by special function keys, you'll need the menus only for less-often-used operations, such as changing formats and saving your work. Best of all, *Write* responds very quickly to commands; since the program and your document both reside in RAM, you never have to wait while *Write* accesses the disk.

Documentation and Support. *Write* comes with a one-hundred-twenty-five-page user manual, complete with a table of contents, index, glossary, appendixes, keyboard overlay, and quick reference card. Not intended as a reference, the entire manual is written in tutorial style. You can try out virtually every feature using step-by-step instructions on a set of sample documents provided on disk. The instructions are written in a friendly style with an abundance of suggestions and helpful hints. The manual's only problem is that it isn't organized logically. Nonetheless, by consulting the index you can usually find the information you're looking for.

Write is copy-protected and comes with one backup disk. Software Publishing Corporation will make updates of the program available to registered users for about $15. You're also entitled to receive Software Publishing Corporation's newsletter, which has product-update information and useful tips on all the PFS programs.

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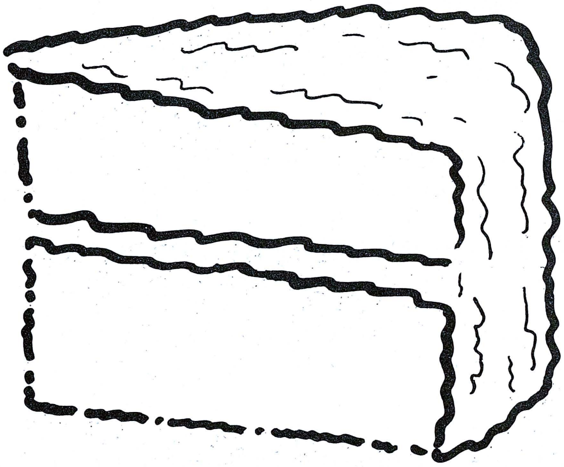

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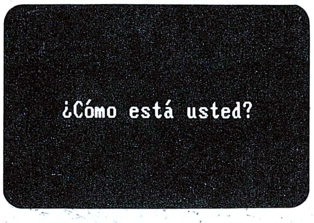

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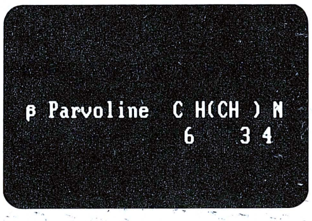

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β Parvoline  C H(CH ) N
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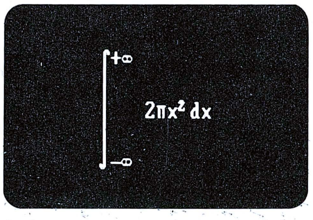

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Audience. *Write* is definitely not Software Publishing Corporation's answer to *WordStar.* But if you're in the market for a word processor that can handle the basics with a minimum of fuss, *Write* is ideal—especially if you're already using one of the other PFS programs.

System Requirements. The program requires 128K of RAM; it won't take advantage of additional memory your system might have. Although you can get by with one disk drive, you'll have to reinsert the program disk at print time and whenever you need on-screen help. The program can also be installed onto the XT's hard disk (and some non-IBM hard disks as well).

Write comes with default settings for the IBM dot-matrix, but it can be set up to work with other printers (serial printers, for example) by means of a utility program.

Software Publishing Corporation has successfully used *Write* with the Compaq and the Hyperion, and they're currently in the process of testing it with the Columbia MPC, the Eagle PC, and the Victor 9000.

MultiMate

MultiMate owes its existence to an enterprising life insurance company that wanted the pc to perform like a dedicated word processor. Not just any word processor, mind you, but specifically the Wang.

Connecticut Mutual Life Insurance Company was looking for a way to integrate a new batch of pcs into their offices without having to retrain secretaries and executives who were already using the Wang. Realizing there were no programs available that fit the bill, they called on the people at Softword Systems to come up with a new program. From that work sprang *WordMate,* which has since been modified and renamed *MultiMate*.

Overall Design. *MultiMate* has a look and feel about it that almost makes you think you've got a dedicated machine at your fingertips. For example, the function buttons, used in various combinations with control, shift, and alt, give you one- or two-keystroke access to almost every feature. Throughout the program, helpful prompts and messages written in plain English (such as "Move what?" "To where?") guide you.

One of *MultiMate*'s most pleasant similarities to dedicated word processors is its practice of automatically saving your work to disk. When you've filled the page you're working on, the program beeps to remind you to begin a new page. The previous page is then automatically saved to disk, whisked out of harm's way.

Except in the editing mode, *MultiMate* is menu-driven. From the main menu you can create a new document, edit an old one, print, create form letters, or run one of the utility programs. You can save time by choosing any of the main menu's options from anywhere in the program—by pressing alt and the number of the desired function.

Text Entry and Editing. A status line that displays the name of your document along with the page, line, and column number of the cursor heads the editing screen. A ruler marking the current tab settings, margins, and line spacing appears below the status line. You will notice a set of arrows in the bottom-right corner of the screen. These arrows ought to become part of every word processing program for the pc: By pointing up or down, they indicate whether you've (intentionally or unintentionally) engaged the caps-lock key or the num-lock key, thereby overcoming what many users find to be an irksome inadequacy of the IBM's keyboard.

MultiMate offers no less than seventeen ways to move the cursor, including jumps to specified page numbers or markers. As a convenience, Softword Systems's designers have located all the keys that affect cursor movement (except the go-to-page key) in the numeric keypad.

The editor is normally in typeover mode. To insert text, you press insert; all but half a line of text is pushed off the bottom of the screen to accommodate the additions. Since the few words remaining on-screen are your only reminder of what follows, it can be difficult to insert several sentences. As a result, you may have to switch between the overtype and insert modes to refer to the trailing text.

In previous versions of the program, you had to do all deleting by entering delete mode and marking the text to be removed. Since this approach proved inconvenient when you wanted to delete a single character, Softword Systems recently modified the program so you can delete the character under the cursor by pressing the minus key. While this is an improvement, you have to alternate between the minus and left arrow keys to delete several characters consecutively. It would be nice if you could delete continuously using the backspace or delete key as you can with many other word processing programs.

If you want to delete several words or lines, position the cursor over the first character, press the delete key, and move the cursor over the text you want to erase. You can easily accomplish this by typing in the last character in the block. For instance, if you enter a carriage return, the cursor will jump to the end of the paragraph, highlighting everything in its path. If you overshoot the targeted text with a fancy cursor move, just use the left arrow key to unhighlight anything you don't want erased. When you're finished marking, press delete again and the highlighted text will be removed.

You can cut and paste by typing the *move* command (F7), after which you are asked, "Move what?" Once you mark the appropriate text by highlighting it, the program asks, "To where?" prompting you to move the cursor to the new location. When you press F7 again, the new text is inserted where you indicated. The copy function works in a similar manner.

MultiMate offers the standard search and replace functions, although it will also find all instances containing a given word. Unfortunately, this means that if you're looking for sea, you'll also get search. If you tell the program to locate sea only when there is a space on both sides, you'll miss any occurrences followed by punctuation. Searching can be done only in the forward direction.

Although earlier versions of *MultiMate* did not support columns, Softword Systems has remedied this situation in the latest release. The program can now copy, insert, delete, and move columns of numbers and text. In addition, the program will now add and subtract vertical columns and horizontal rows of numbers. These new capabilities, along with horizontal scrolling (up to one hundred fifty-six columns) and decimal tabbing, give you all the column help you will need.

There is one problem with the column move feature, however: Sometimes the carriage returns following the numbers are also moved, causing the format of any columns to the left to be destroyed.

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Formatting and Printing. *MultiMate* presents text on-screen as it will appear on the printed page, with some notable exceptions. No matter what line spacing you choose, the document always appears single-spaced. This arrangement seems logical, since it allows you to see the maximum number of lines per screenful, but it can, at times, be a disadvantage. Anyone who has spent hours on end at the keyboard knows that double-spacing strains tired eyes less. Other features that don't show up on-screen include double-striking and full justification.

MultiMate makes defining your document's layout a breeze. Pressing F9 places the cursor on the ruler; you then move the cursor to change line spacing, tab stops, and the right margin setting. You can change formats anywhere in a document, even in the middle of a page, by creating a new ruler. The settings you've chosen are stored with the document so that you don't have to reset them each time you edit. *MultiMate* automatically reforms your text according to the new format changes, just as dedicated machines do, eliminating the necessity to reform each paragraph manually.

The program, unfortunately, lacks hyphen help, a virtual necessity if you want to create attractive, fully justified text. You can, however, insert ghost hyphens if you can figure out where they're needed.

MultiMate's method of pagination is similar to that used by many dedicated systems. Unlike most other pc word processing programs, which automatically place page breaks after a preset number of lines, this program gives you the option of setting breaks where you want them. You specify the approximate number of lines you want per page, and you hear a beep when you reach that limit. You can enter up to one hundred fifty lines on a page—this means you can easily squeeze a few more lines at the bottom of the page if necessary. With most of the word processing programs for the pc, you can end a page before the preset limit, but never after it.

The program allows headers and footers of up to five lines; and for bound manuscripts, a different header or footer can be printed on alternate pages. However, *MultiMate* doesn't do automatic footnoting.

MultiMate's print-format screen is a hands-down winner for the busiest screen in a word processing program. It includes a plethora of information about the document to be printed, seventeen options, and a list of sixteen printers that can be used. Fortunately, once you get used to the program, the table really isn't that bad. In fact, if you don't want to fool with this table each time you print, you can save the default settings on disk.

Although busy, the print-format screen's complexity gives you precise control over printing. You can set up a list of documents (a queue) to be printed automatically one after the other, and you can do background printing (spooling). You can even set the printing process to begin automatically at a preset hour of the day. This means that, if you share a printer, you can schedule your pc to begin printing at an assigned time.

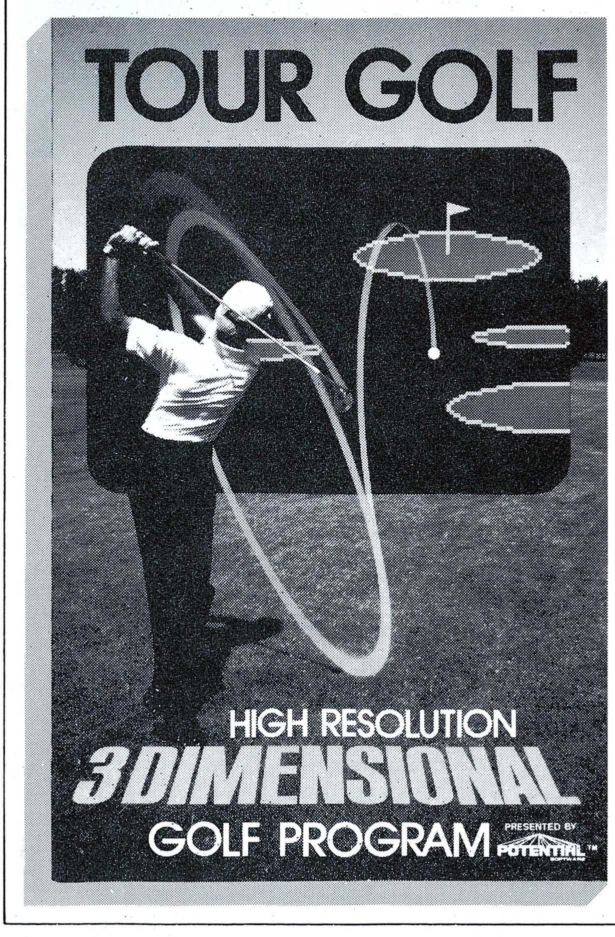
File Handling. *MultiMate*'s file directory is comprehensive. It lists the name of the document (up to twenty characters rather than the usual eight), the author, the addressee, key words for identification of the document (see following paragraph), summary comments, the creation date, and the most recent editing date. The creation date and the most recent editing date are automatically filled in from DOS or, if you have one, from an on-board clock.

What's even more exceptional is the program's ability to search for documents using information from the file directory. This feature allows you to identify any or all documents created by the same author, addressed to the same person, or containing the key words you've specified. This is especially useful if you store a large number of documents on a hard disk. As another plus, the directory information can be printed to give you a short description of each document.

MultiMate allows you to create keyboard macros for frequently used text. You create a library of phrases by naming the library and entering each macro along with a three-character identification code; you can set up different libraries for each type of document you write. To use a library with a document, you must first indicate which library you want to use. Then, to invoke a macro from that library, you press F5 followed by the three-character ID code; the program instantly inserts the text at the cursor's position. You can't, at present, set up macros of commands (the way you can with *ProKey*), but Software Systems says they'll add this capability to the next revision of *MultiMate*.

Because of the large number of control codes embedded within the text, files created by *MultiMate* can't be used with other word processing, spelling checker, or telecommunication programs without modification. A utility program is provided that converts *MultiMate* files to standard ASCII files. When we tested this program, however, we found that it changed the format of some text and often lost the last line on a page.

Mailing List Program. *MultiMate* includes a mailing list program that allows you to generate form letters. You first create the form letter with variables inserted wherever you want information to be merged and then set up the



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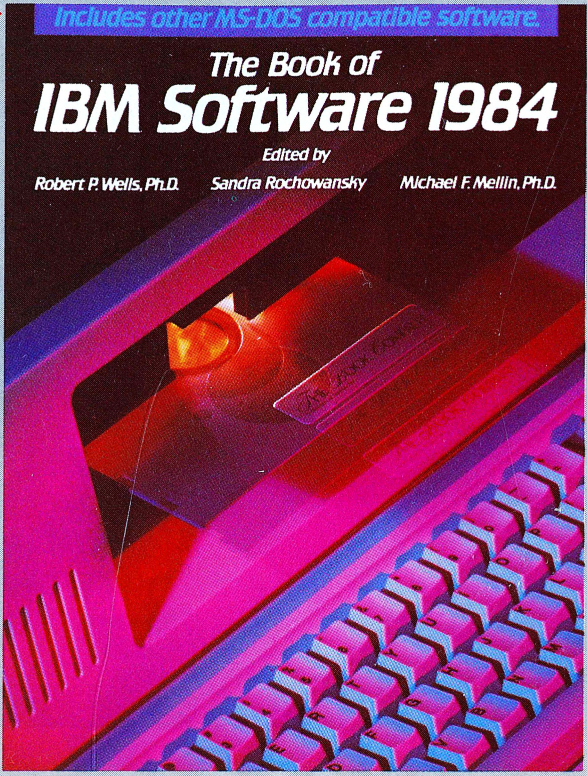

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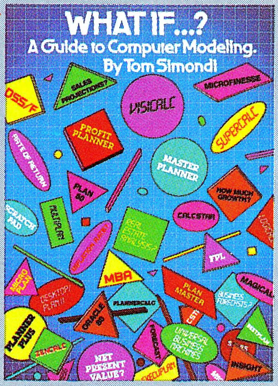

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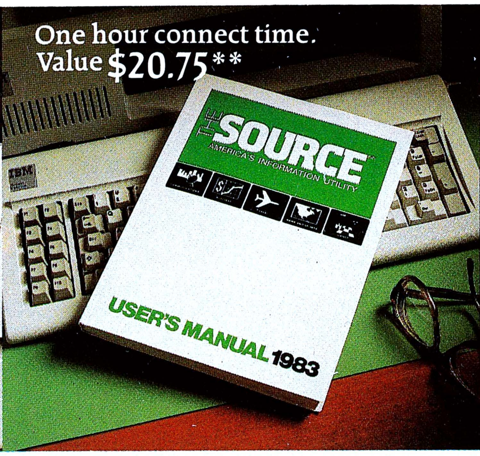

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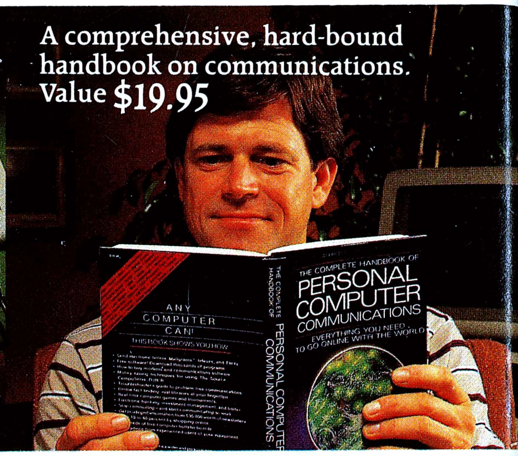

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mailing list itself. Since the program doesn't force you to use a predefined form, you have a lot of flexibility in the information you may want to include. Unfortunately, the price you pay for this freedom is a lot of extra typing—you have to type in each variable name along with its value for every new record. The problem is compounded by the requirement that you type alt-M to mark the beginning and end of each field. You then call up the merge screen from the main menu and enter the names of the files containing the form letter and the data to be merged; finally, you print the letters just as you would any other document.

Ease of Learning and Use. Because it's logically designed, *MultiMate* is relatively simple to learn—notwithstanding the number of features it offers. When in virgin territory, you can usually go with your instincts without courting disaster. If you don't trust your instincts, you can use the on-line help feature to list the key assignments or information about specific features.

Through careful attention to detail, Softword Systems has made this program ergonomically efficient. For example, since all the cursor movement keys are located together on the right side of the keyboard, you don't waste time hunting for the correct key. And, as already mentioned, you can bypass the main menu to hurry things along.

Documentation and Support. *MultiMate*'s manual appears very professional. It's printed on heavy stock, the type is large and bold, and the screen outputs are highlighted in green print. The manual converts into an easel for placement beside the keyboard.

But looks can be deceiving. The reference section's step-by-step instructions only minimally describe each feature; it's impossible to take full advantage of a program this powerful without its features being described in greater detail. Fortunately, the people at Softword Systems are aware of this problem and are just finishing an expanded version of the current manual.

In addition to the reference section, the manual contains a three-lesson tutorial that gives you a nice introduction to the program. A set of stick-on key labels is provided along with a chart showing you what keys perform which functions.

Software Systems hasn't copy-protected *MultiMate*. They have provided a telephone hotline for questions; the technical support personnel are both patient and knowledgeable.

Since *MultiMate* is in the process of evolving, with new features being added periodically, the company offers free updates for six months following purchase. Enhancements to be included in the next update (which should be out soon) are a spelling checker, sheet feeder support, and proportional spacing.

Audience. *MultiMate* should make anyone looking for a powerful yet easy-to-use word processor happy; it is well suited to business environments, especially those in which some users will be switching over from dedicated machines or in which several pcs are networked with a common hard disk and printer.

System Requirements. With DOS 2.0 you need 192K of RAM, while with DOS 1.1 you can get by with 128K. Over twenty different printers are supported; Softword Systems will modify *MultiMate* to work with any printer if you send them the printer's manual—now that's support.

Softword Systems has successfully tested *MultiMate* with the Compaq, Chameleon, Hyperion, Columbia, Corona, and Victor 9000.

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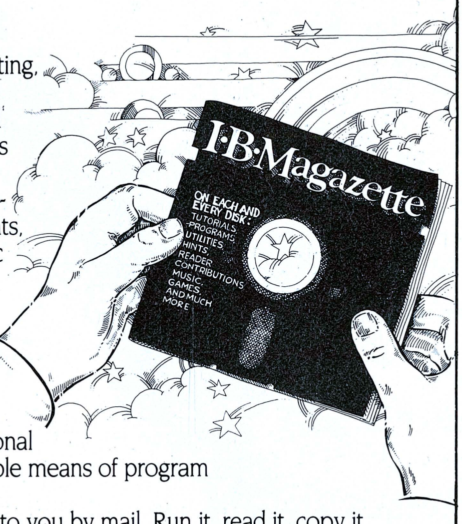

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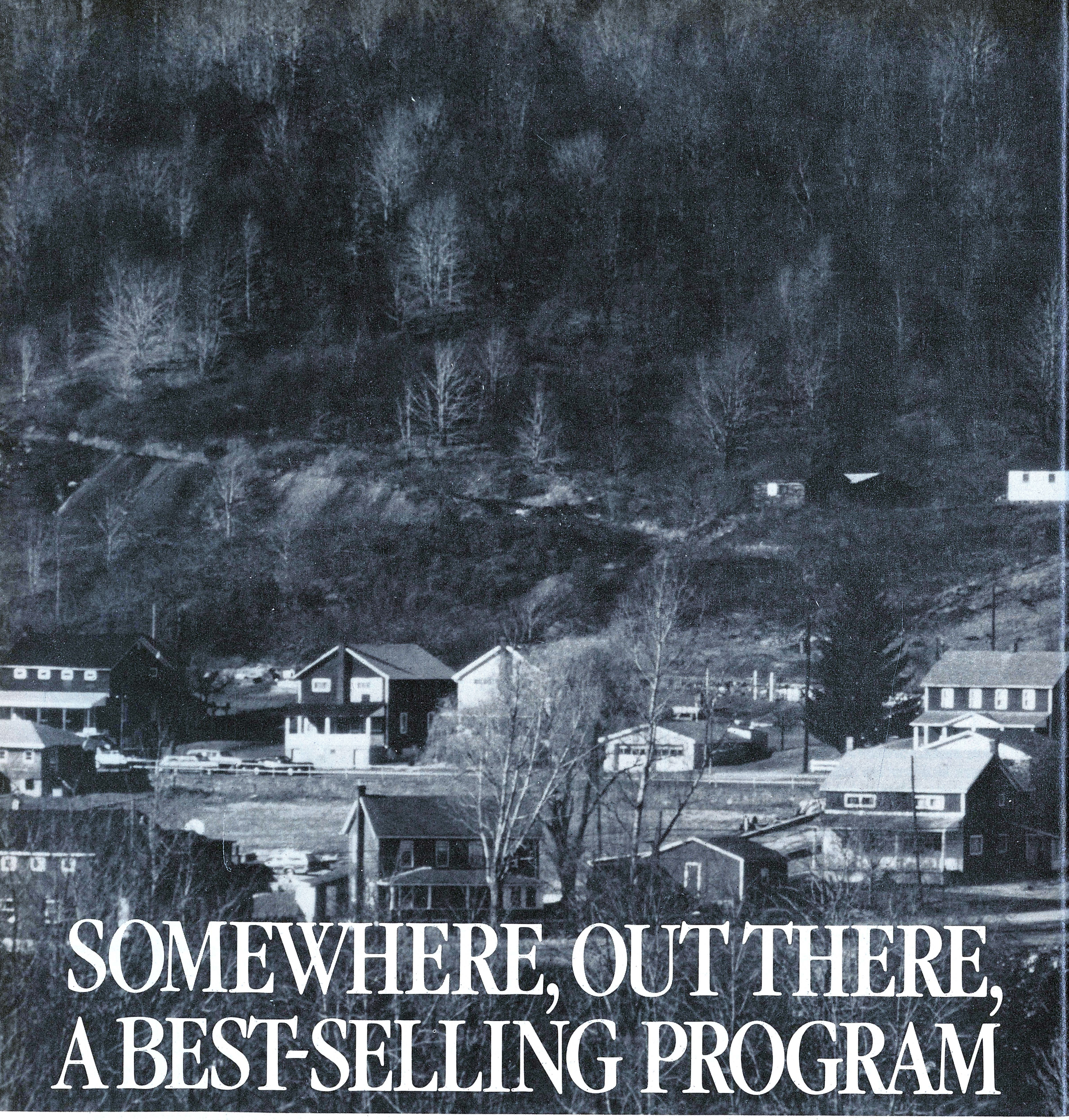

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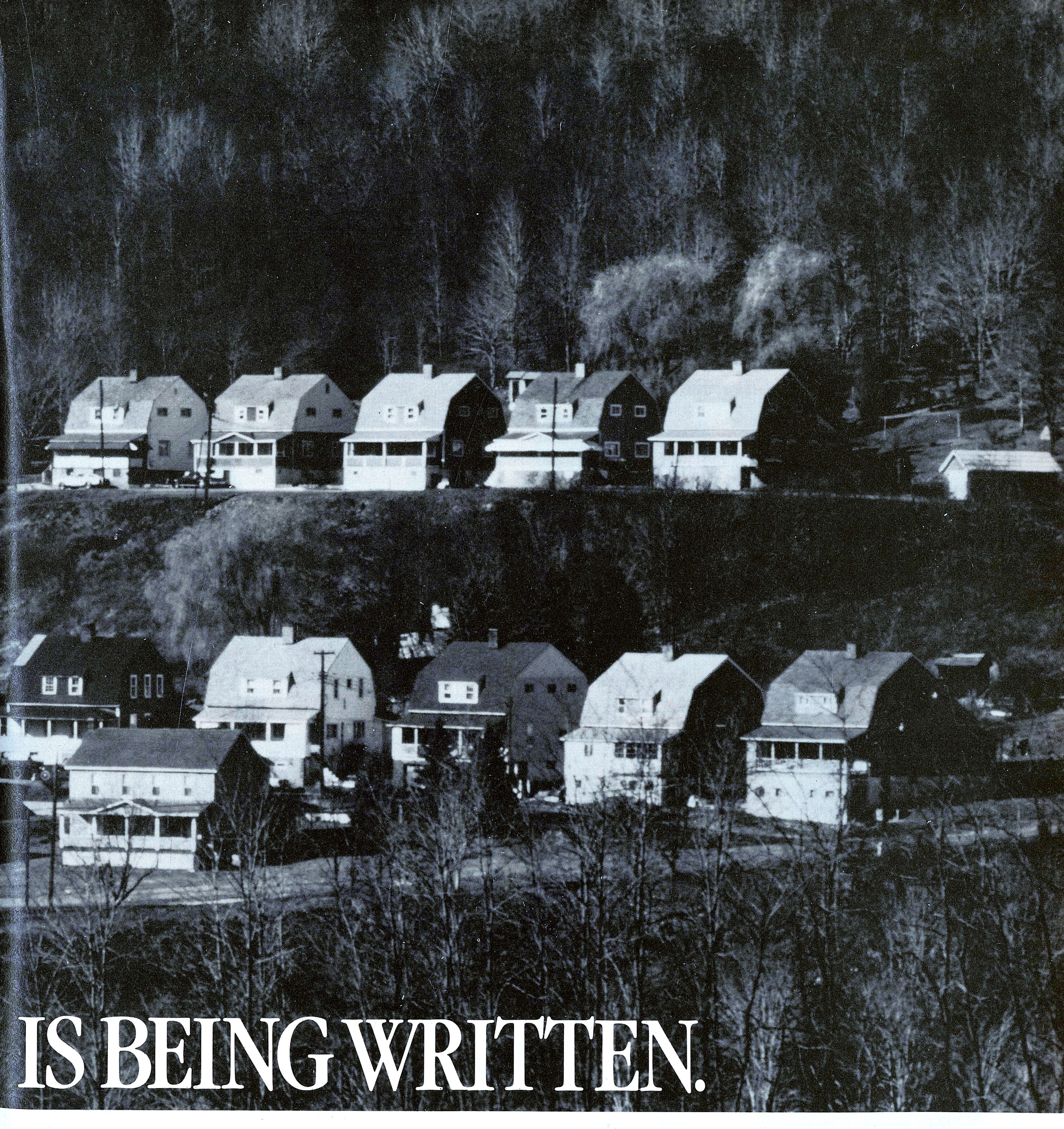

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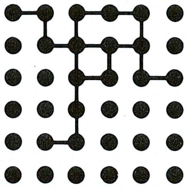
Conclusion

A PRIMER ON NETWORKING



by Bruce Churchill

The following is the final installment in a series of five articles excerpted from the book Communications and Networking for the IBM PC, *by Larry Jordan and Bruce Churchill, published by the Robert J. Brady Co. (Note: This material was written before the introduction of DOS 2.0.)*

This month we conclude our survey of the first three local area networks to be implemented on the IBM Personal Computer. In this installment we'll look at *EtherLink*, from 3Com (1390 Shorebird Way, Mountain View, CA; 415-961-9602).

Overview

EtherLink is hardware and software that connects as few as two or as many as one hundred pcs via a single segment of network cable and allows them to share floppy drives and printer resources.

EtherLink is the first local area network for the IBM pc designed in accordance with Ethernet specifications. And because *EtherLink* is an Ethernet-compatible LAN, it supports multiple segments, connected to one another by means of devices known as repeaters. These repeaters make several physical segments appear to be one logical network.

EtherLink runs under PC-DOS. Everything, except for the additional operating-system-level commands necessary to establish links between user pcs and server pcs, is transparent to the user.

Each pc in the Ethernet LAN requires a network adapter card containing the standard Ethernet logic circuits and firmware.

Although floppy disk drives and a printer can be shared among networked pcs, hard disks cannot. The addition of the *EtherShare* network server allows for the sharing of up to seventy-two megabytes of hard-disk storage capacity. Two software packages, *EtherPrint* and *EtherMail*, available separately, can also be connected into this server. If no *EtherShare* server is present, a printer can be attached to one or more pcs that have been designated servers; these server pcs also provide shared floppy disk resources.

The manufacturer of this product, 3Com, uses the name *EtherLink* to refer to the basic network and its supporting software but does not necessarily include *EtherShare*, *EtherPrint*, or *EtherMail* under that banner. For purposes of this article, however, we'll extend the term *EtherLink* to describe all the components the company provides to set up an LAN; these would include not only the basic system hardware and software but also the extra servers and their accompanying software packages.

EtherLink Hardware

The hardware associated with *EtherLink* comprises network bus components, the *EtherShare* network server, and the adapter card(s). We'll now discuss each of these elements in more detail.

Network Bus Components. The *EtherLink* data path is formed by coaxial cable—either RG-58A/U thin coaxial with BNC-type hardware, or the commercial-grade Ethernet thick coaxial with N-type hardware. Thin cable can be connected directly to an adapter card with a BNC T-connector, in an arrangement similar to the hardware connections in PCNet I, while thick cable requires an external transceiver and a cable tap. Thick and thin cable may be intermingled on the same network so long as basic network configuration rules are followed. These rules, which conform to Ethernet specifications, are summarized in table 1 and illustrated in figure 1.

Although thick cable allows for longer segments, it is considerably more difficult to install. In addition, thick cable is more expensive—it costs more per linear foot than thin cable, and extra hardware is required at each device connection point. Examples of network installations for both the thick and thin bus cases are shown in figures 2 and 3.

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EtherShare Network Server. Although it does not function as a network workstation, this hardware component is a general-purpose microcomputer. The server uses an Intel 8086 processor operating at 10 MHz and has 512K of parity-checked random access memory.

Any number of servers can be placed on *EtherLink*, although the cost of these devices would tend to put a limit somewhere.

Each server comes with a keyboard, video display, and *EtherLink* adapter card. Each station can be equipped with either ten or thirty-six megabytes of hard-disk storage and one drive of equal capacity can also be added externally. It is thus possible to have 10, 20, 36, or 72 megabytes of hard disk storage.

Each server can be equipped with a one-megabyte 5 1/4-inch floppy disk drive for backup purposes. A seventeen-megabyte cartridge tape drive is another optional peripheral. Each server can accommodate either one or two printers.

Adapter Card. Each device, or node, on the network must have an *EtherLink* network adapter card installed. This adapter card contains the circuitry and firmware required to implement layers 1 and 2—physical and data link—of the seven-layer ISO model (see the August installment of this series). The adapter card comes with a transceiver capable of driving the thin Ethernet cable. As mentioned earlier, the thick Ethernet installation requires an external transceiver, which can be supplied by 3Com or by the Xerox Corporation.

The adapter card handles a number of functions required for proper network operation. Among these are DMA (direct memory access) transfer operations with the host computer's RAM, the formatting of data into Ethernet packets for transmission, the passing of received data packets to the host pc's operating system, data error checking, data encoding and decoding, and access control in accordance with the Ethernet CSMA/CD protocol. Because the Ethernet CSMA/CD access protocol is widely used, let's take a moment to look at it more closely.

The *EtherLink* adapter card implements the full CSMA/CD protocol according to the Ethernet specification. With data packet sizes ranging from 64 to 1,518 bytes, this protocol

The Twelve Commandments of Ethernet

I. 100 nodes maximum on any single segment
II. Nodes must be at least 2.5 meters apart
III. Node is defined as an addressable entity connected via:
  - Cable tap (T-connector for thin cable)
  - Transceiver (on adapter card for thin system)
  - Controller (on adapter card for thin system)
IV. Any number of devices may be connected to a node
V. Repeaters may be placed at any or every node position
VI. Maximum length of cable between any two nodes is 1,500 meters
VII. Maximum segment length:
  - 300 m Thin Ethernet
  - 500 m Thick Ethernet with non-3Com transceivers
  - 1,000 m Thick Ethernet with 3Com transceivers
VIII. Maximum length of transceiver cable is 50 meters (adapter card to thick cable transceiver)
IX. Maximum of two repeaters in a path between any two nodes
X. Maximum of 1,000 meters for a point-to-point link
XI. Maximum end-to-end network length is 2,800 meters
XII. Maximum of 1,024 nodes on a complete network.

Table 1.

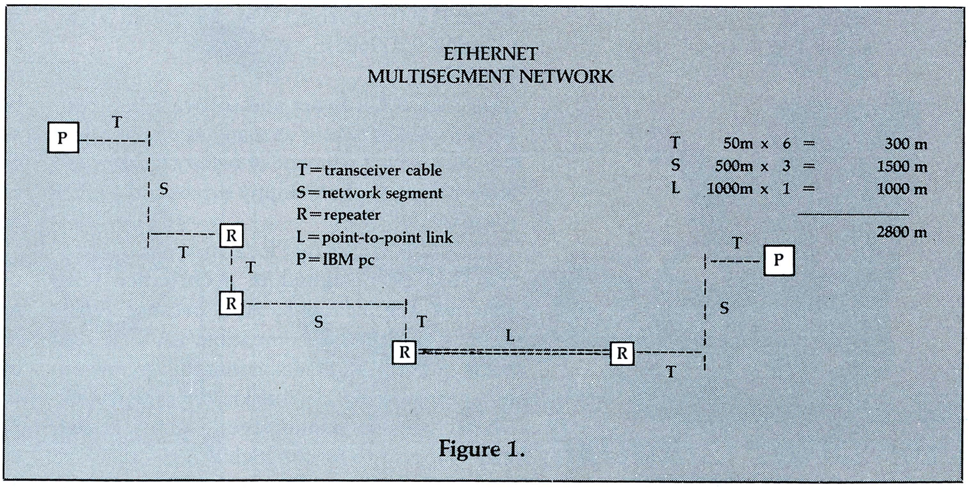

Figure 1.

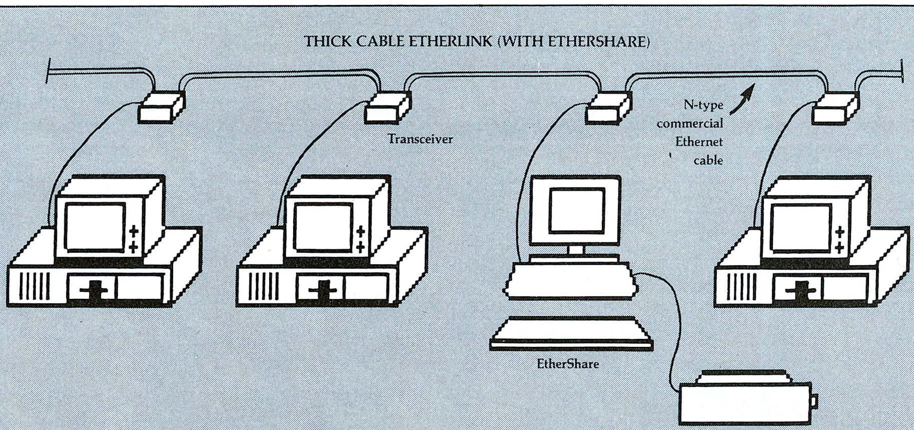
THICK CABLE ETHERLINK (WITH ETHERSHARE)
Transceiver
N-type commercial Ethernet cable
EtherShare

Figure 2.

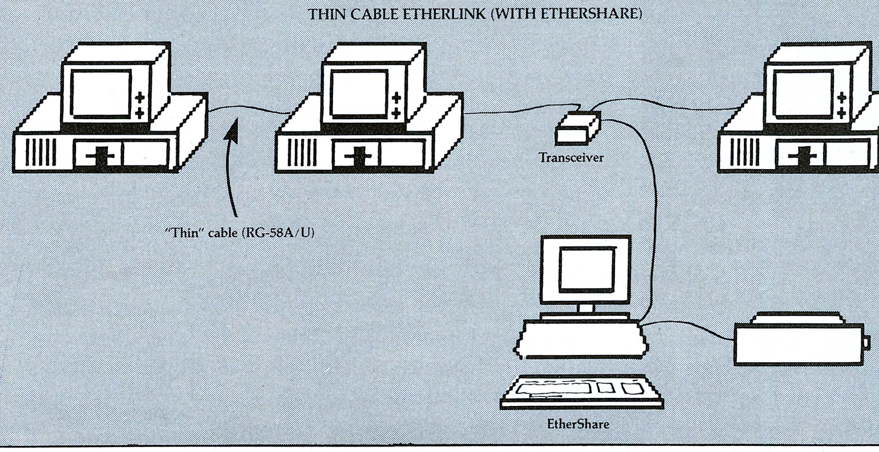
THIN CABLE ETHERLINK (WITH ETHERSHARE)
Transceiver
"Thin" cable (RG-58A/U)
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Figure 3.

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supports a network configuration of up to 2.8 kilometers between any two workstations. A multisegment Ethernet (or *EtherLink*) LAN is pictured in figure 1.

The *EtherLink* packet format is shown in figure 4.

Maximum packet size is based on efficiency and the desire to minimize collisions (two or more data packets on the network simultaneously). Minimum packet size is chosen to guarantee collision detection (CD) at maximum network sizes. Figure 5 illustrates how minimum packet size and maximum network size interact to provide collision detection under the "worst case" condition.

Transmitting sixty-four bytes of data takes 51.2 microseconds at a ten-megabit data rate. This is approximately equal to the amount of time required for a bit of data to make the round trip between two pcs located at the extremities of the networks illustrated in figures 1 and 5. If pc A commences a packet transmission on the network, pc B won't sense the carrier until A's packet begins to arrive. If pc B were to start a transmission just prior to the arrival of A's packet, as the CSMA/CD protocol would allow, a collision would be generated at B when A's packet arrived. B would then transmit a collision signal, which would begin to arrive at A while A was still transmitting the original sixty-four-byte packet. Thus, the adapter card in A would also detect a collision and begin its collision-recovery routine. This routine consists of continuing the transmission process for a short interval in order to generate the collision signal just mentioned (this is known as a *jam transmission*), followed by a random period of silence before attempting to send the packet. Since this is the worst-case example, it means that any longer packet size and any two nodes closer together on the network will also have guaranteed collision detection.

The logic we've just been discussing is the most difficult part of the CSMA/CD protocol to understand. The remaining aspects of this access-control method are relatively straightforward.

If the physical layer of a station does not sense a carrier, it signals the data link layer to begin transmission of one or more data packets. On a baseband network such as *EtherLink*, a "carrier" is actually the presence of digital signal transmissions from bit to bit. Once the packets are transmitted, the collision-detect logic works as described above. With Ethernet packet sizes, the percentage of collisions is quite low (less than 1 percent), even on relatively large and busy networks. Therefore, business users of *EtherLink* or a similar LAN need not be overly concerned about degraded performance as a result of collisions.

EtherLink Software

Basic System. *EtherLink* software is supplied in the basic system (without *EtherShare*) to allow designated pcs to be set up as server pcs. While it is so designated, a server pc cannot be used to run other application programs. There is no limit to the number of pcs that may be set up as servers. And any printer or floppy I/O

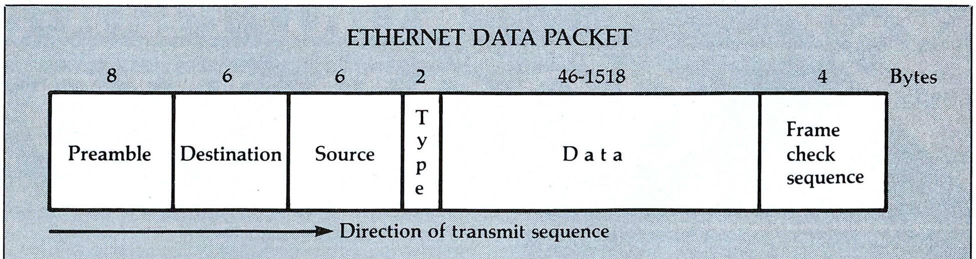

Figure 4.

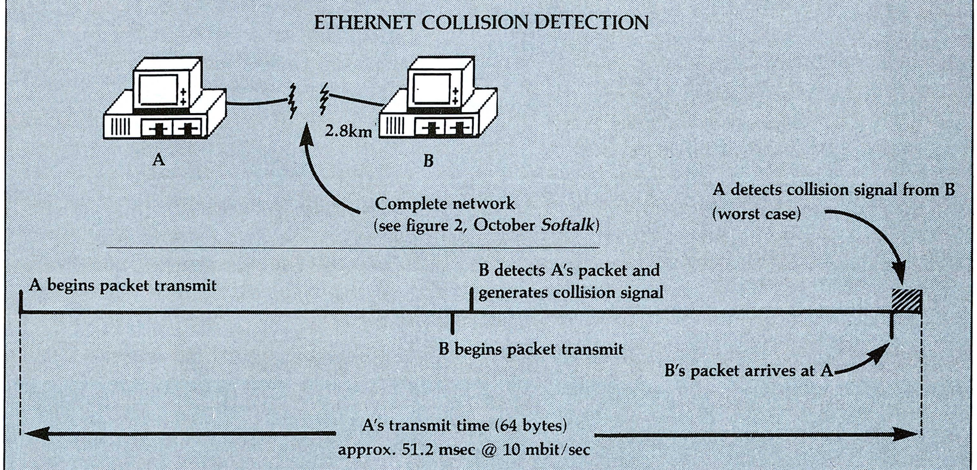
ETHERNET COLLISION DETECTION
A
2.8km
B
Complete network (see figure 2, October Softalk)
A detects collision signal from B (worst case)
A begins packet transmit
B detects A's packet and generates collision signal
B begins packet transmit
B's packet arrives at A
A's transmit time (64 bytes) approx. 51.2 msec @ 10 mbit/sec

Figure 5.

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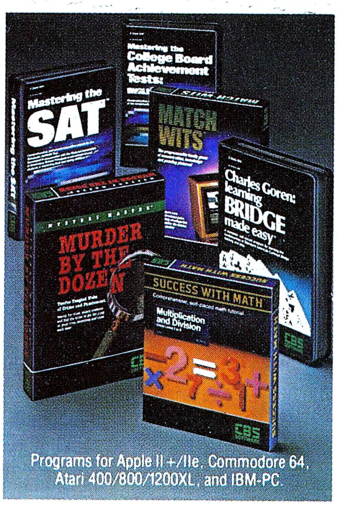
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device that can be attached to a pc can become a shared resource. For example, the following sequence can be used to establish a pc as a server named Server1, with drive B (write-protected) and line printer Lpt2: available as shared resources:

```
A>PCSERVER [executes
  PCSERVER.COM program]
  Server name?     SERVER1
  Server drive ID?  B:
  Write protect?  Y
  Server printer ID?  LPT2:
```

This command could also have been entered as:

```
A>PCSERVER SERVER1 B:        /WP LPT2:
```

From this point on, all pcs in the *EtherLink* network can access Server1, but they can do so only one at a time. The user pc links a local driver designator (in this case, C:) to the shared floppy with the following command:

```
A>EL LINK C: SERVER1
```

The effect of this command is to make drive B on Server1 available as logical drive C on the user pc workstation. Local drive designators A through D can be linked to the named server's shared drive. Although linked access to a server pc is exclusive (only one user pc linked to a resource at a time), the user pc may link to the floppy and printer simultaneously. Only one drive and one printer on a server pc may be designated as shared resources.

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Figure 6 illustrates the general capabilities and limitations of *EtherLink*'s basic software. It should be obvious from this simplified example that the capability for multiple users to access the basic *EtherLink* network is limited when only one server is designated. In fact, when more than one server is designated, only that number of virtual circuits can be in use at any given moment, regardless of how many pcs are connected to the network. On networks with a relatively large number of user pcs, this arrangement wastes *EtherLink*'s capacity. On an *EtherLink* network that contained an *EtherShare* server, the problem would not be noticeable.

Compatibility of existing IBM pc software must be carefully assessed before applications are planned on an *EtherLink* network. Generally speaking, if a software package is to be compatible, the following criteria must be met: The package must run in PC-DOS and use standard floppy disk and printer drivers. The code must be relocatable in user RAM, and there must be sufficient room in RAM for program code and data; and the program must not require physical insertion of a disk during operation.

Representative programs and the degree to which they meet these criteria are listed in table 2. The programs are shown there to help give you a feel for compatibility requirements. Keep in mind that later versions of some of the programs listed as incompatible may now meet the compatibility criteria after all.

EtherShare Software. The addition of the *EtherShare* server to the *EtherLink* network adds a new dimension to its usefulness in the business environment. Hard-disk resources require the addition of this separate microcomputer and the *EtherShare* software package. The hard disk drives are provided by 3Com with the *EtherShare* server; network server software does not support other types of drives.

EtherShare is made up of three distinct parts: the *EtherShare* server, which manages all *EtherShare* resources, such as hard-disk volumes and printers; the *EtherShare* administrative program, which performs housekeeping jobs on the server; and the *EtherShare* commands, which are executed from a command file on each user pc's local drive (usually drive A).

Fourteen *EtherShare* commands are accessible by each user on the *EtherLink* network. These commands allow the user to log in and log out from the server by user name, create or delete *EtherShare* volumes, link local floppy drive designators to *EtherShare* volumes, modify user access and volume parameters, and display directories of network users and volumes.

EtherLink Software Compatibility

Compatible Software	Incompatible Software
VisiCalc*	EasyWriter 1.0
SuperCalc	VisiTrend/Plot 1.0
EasyWriter 1.1*	VisiDex 1.0
PFS:File*	VisiSchedule
PFS:Graph*	Time Manager
Desktop/Plan*	
WordStar	
VisiFile	

*These programs are self-booting and are loaded with the command *el boot*. This allows the network linkages between the user and server pcs to remain intact. A normal warm boot would break any existing links.

Table 2.

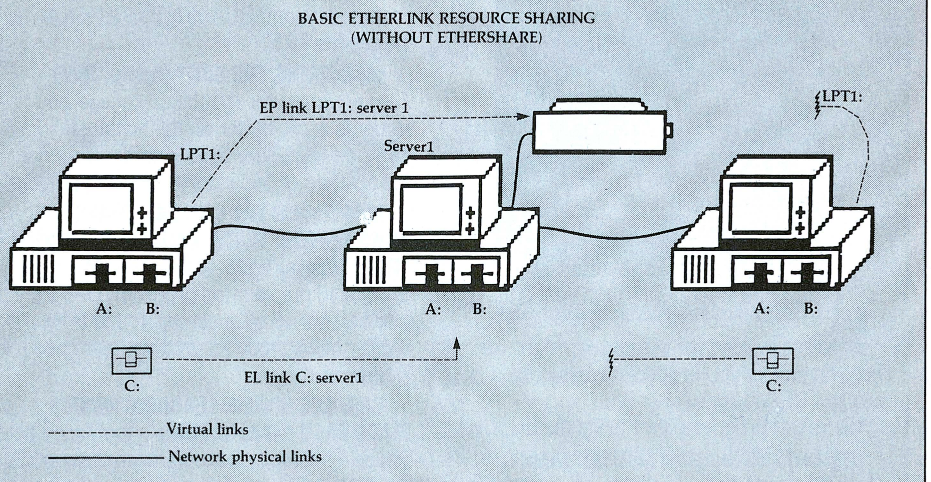

Figure 6.

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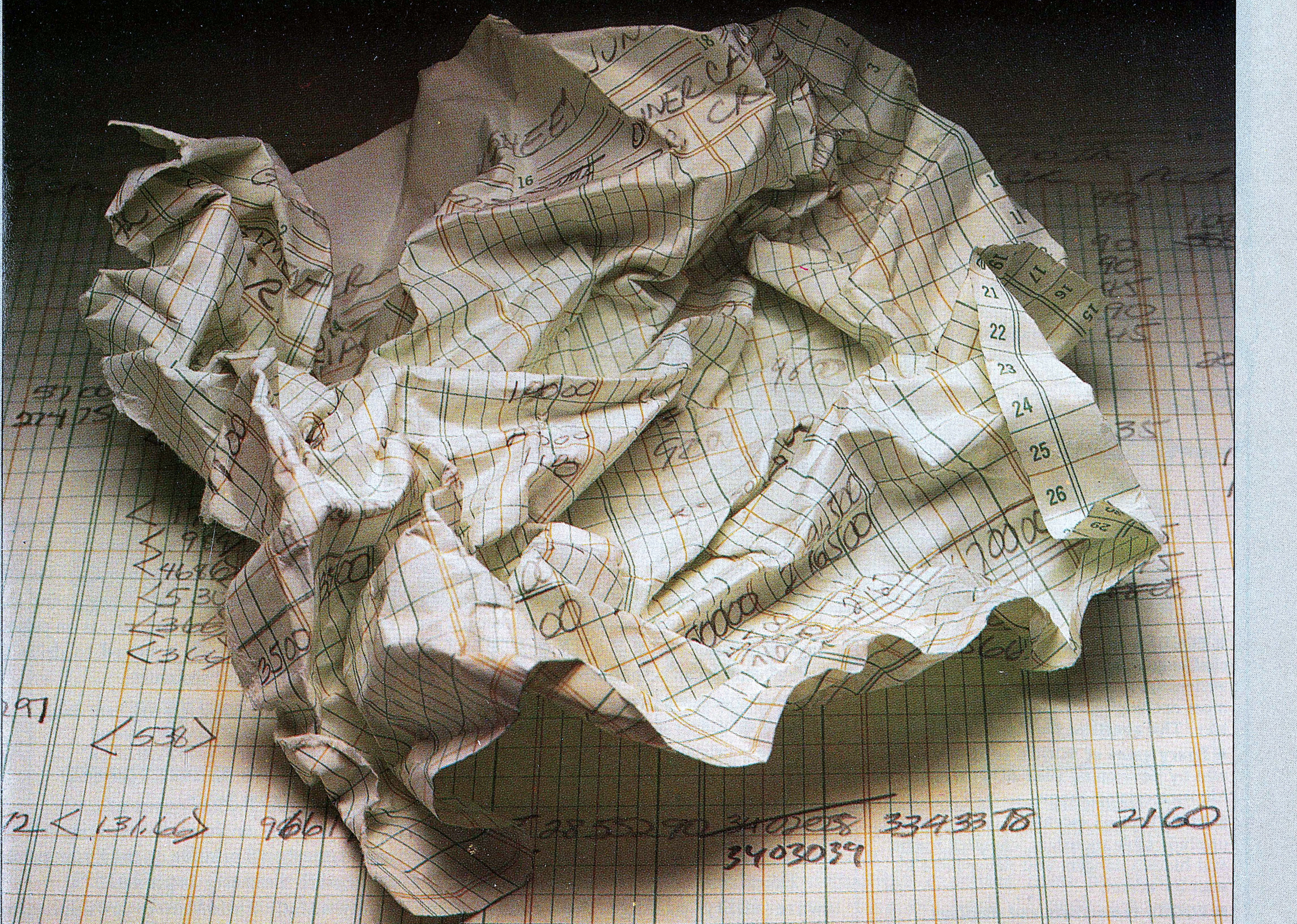

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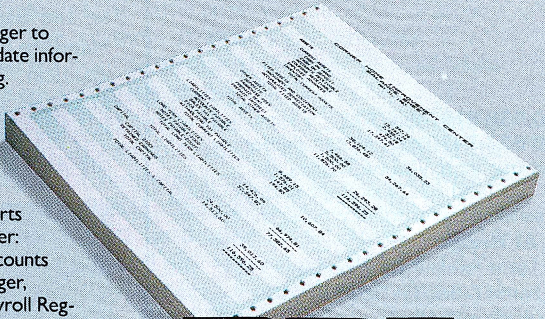

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Volumes can be established on the hard disk as either 160K or 320K areas. In this context, a volume simulates the presence of an additional single- or double-sided floppy drive. A ten-megabyte drive can accommodate about thirty double-sided floppy equivalents, or a proportionately higher number if some volumes are single-sided equivalents. Any user on the network can link from one to three local drive designators to the *EtherShare* server. The allowable drive designators are A:, B:, C:, and D:, just as in the basic *EtherLink* software. The normal procedure would be to allocate drive A to the local floppy and to link B, C, or D to appropriate hard-disk volumes. A single user would then have access to a maximum of 1.28 megabytes of combined floppy and hard-disk mass storage.

An individual user may establish only one set of links (drive designators to volume names) to a given server at a time. Over the entire network, however, any number of links may be set up from multiple users, up to the limit of the server capacity. The job of the *EtherShare* housekeeping software is to sort out the flow of data to and from the server when multiple users are accessing the hard disk.

File protection is accomplished by means of passwords and a simple scheme of access control. Protection is provided only to the volume level of storage; individual files and records are not protected.

A volume can be public or private. If a volume is public, everyone on the network has access to it, unless a password is assigned; if a volume is private, only the creator of that volume has access. Passwords can be assigned to any volume. Table 3 summarizes the protection scheme maintained by *EtherShare* software.

EtherPrint. *EtherPrint* is supplied as a software utility package that runs on the *EtherShare* server and on user pcs. It performs in similar fashion to the print-sharing software on the basic *EtherLink* network. The commands to link and unlink printer resources are identical. The major difference between the *EtherLink* network software and *EtherPrint* is that the latter allows the use of two printers on the server. Print files are queued in the *EtherShare* server on a first-in first-out basis until the selected printer is available. Once a printer link is established between a pc and one of the two print devices, normal PC-DOS or Basic print commands can be executed on the selected printer.

The following sequence illustrates how *EtherPrint* can be used to print a final report (produced in *WordStar*) on a letter-quality printer attached to the server (Server1). The first step is to establish the printer link:

```
A>EP LINK ?
Your printer ID?   LPT1: [what printer device to link]
To whom?   SERVER1 [designate the proper server]
SERVER1 linked to LPT1: [confirmation of link]
```

In the event that a review of *EtherShare* printer assignment is desired, the following sequence can be used to list printers attached to the server:

```
>EP DIR ? [list printers on the server]
Server?   SERVER1 [designate the proper server]
A>EP LINK   LPT1: /? [what printers are attached?]
Printer(s) supported by the server:
        1 -DIABLO
        2 -EPSON
Selection?   2 [use the Epson printer]
SERVER1 linked to LPT1: [confirmation]
```

The next step is to load *WordStar* from a shared volume on the hard disk. Let's assume that *WordStar* is located on public volume WordProc, which is linked to drive B, and that the file to be printed, *Report.doc*, is on private volume Myfiles, which is linked to drive C. Here's the command sequence:

```
A>B:WS  [load WordStar from the hard disk]
P [Print file from WordStar's no-file menu]
Name of file to print?   C:REPORT.DOC
        [Now answer the print file questions]
Ready printer, press Return
```

The report file on hard-disk volume Myfiles would now begin printing on the Epson printer attached to the server as printer 2.

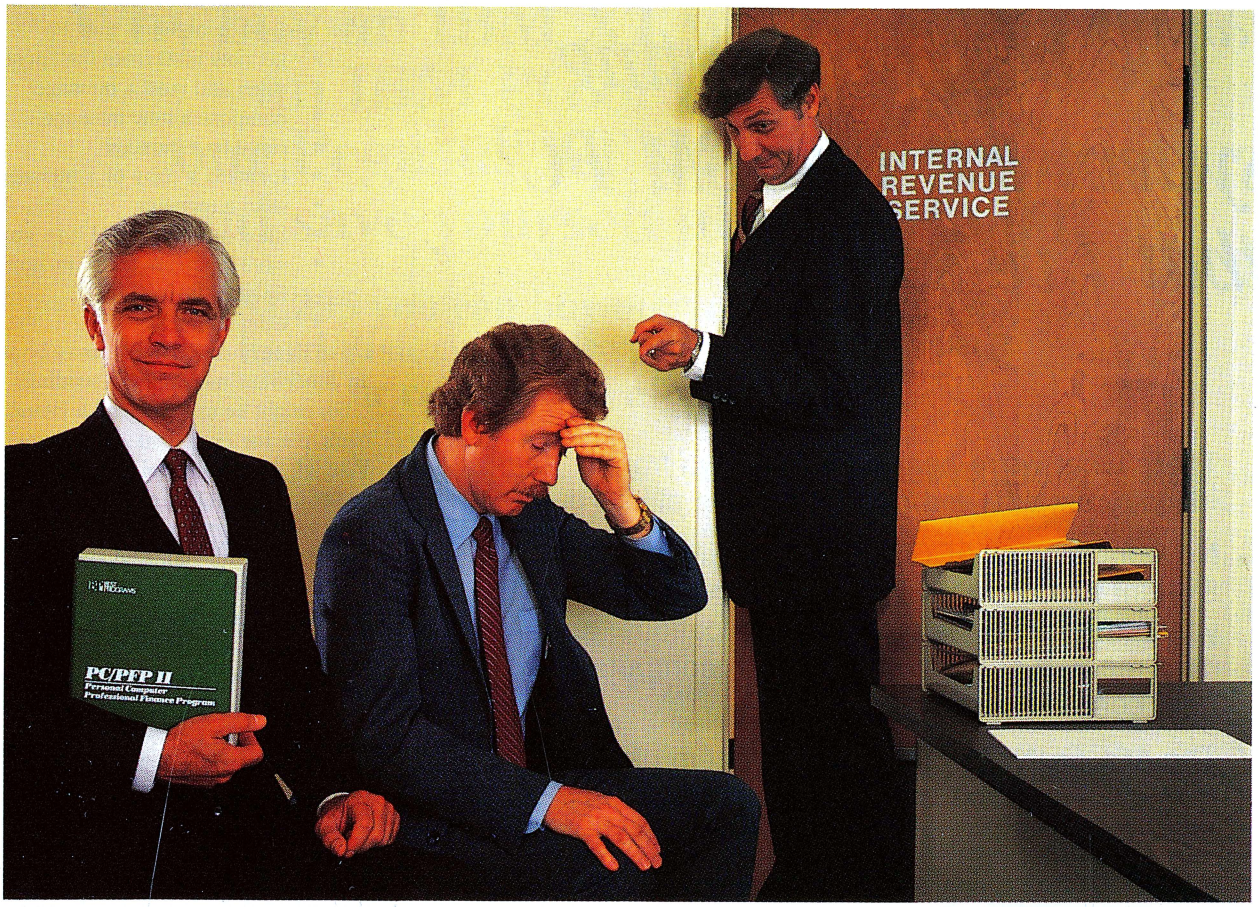
EtherMail. *EtherMail* is an application package designed to run on the *EtherShare* server and on networked pcs. The server acts as a post office and mail administrator for the network; each user pc runs an *EtherMail* program that provides the network mail capabilities we'll look at now.

EtherMail is an internal message processing system; there is no tie-in to modem networks

EtherShare Volume Protection

Volume Access	Password Assigned	No Password
Public—many users; shared access	Password required	Anyone can use
Private—only one user can access; exclusive access	Password required	Only the creator may use

Table 3.



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through gateways or modem servers. *EtherMail* allows the network user to

- get new mail from the "post office"
- open and read a message
- compose a new message
- reply to a message
- forward a copy of a message
- send a message
- file a message (send it to yourself)
- save a message in progress (to be finished later)
- delete a message

Up to twenty-six DOS files may be attached to an *EtherMail* message for sending; this capability might be used to send a *WordStar* document file for comment or perhaps to send a *VisiCalc* budget model as an update to a cost center's entries. You can send mail automatically to predefined groups of recipients by entering only a file name. A text editor included in the software is automatically invoked when messages are created, replied to, or forwarded. This editor may also be used off-line. Any other editor or word processor may also be used, and the resulting file may be sent as an attachment to a normal message.

The *EtherShare* server's primary functions in the *EtherMail* process are to accept and distribute a user's messages, checking all servers on the network to find the proper addressees. If more than one server is present, each active user on the *EtherLink* network must be logged on to a specific server. Message routing is transparent to the user. The server also accepts messages addressed to all logged-in users, holding them in the "post office" until recipients wish to retrieve their mail. In addition to maintaining the post office, the *EtherShare* server maintains personal "mail folders" for the users who normally log on to that server. These mail folders are managed by the users, not by the *EtherShare* post office.

In keeping with our continuing effort to compare network costs, let's refer now to figure 7. The eight-member *EtherLink* network shown there, with a ten-megabyte hard disk, requires eight *EtherLink* adapter cards at $950 each, two hundred feet of thin coaxial cable at $80 (custom assembled), one terminator kit at $25, and one *EtherShare* network server, costing $11,500. The nominal cost for this network would be $19,205. *EtherPrint* software, *EtherMail* software, and use of the commercial standard Ethernet cable and its associated transceivers would result in additional costs. Repeaters to extend the network to a multisegment installation cost approximately $1,300.

Before rejecting *EtherLink* out of hand because it appears to be so costly, remember that it is fully Ethernet compatible and may be the only solution where tie-in to an existing Ethernet or expansion to a full-size Ethernet is required. From a cost-benefit standpoint, this network is most appropriate where the num-

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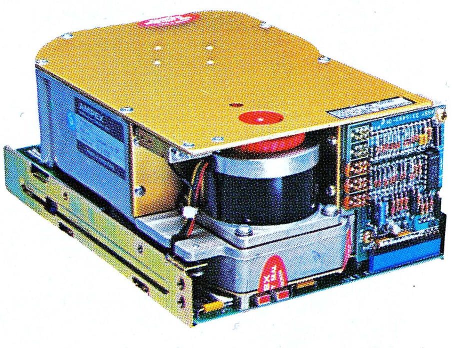

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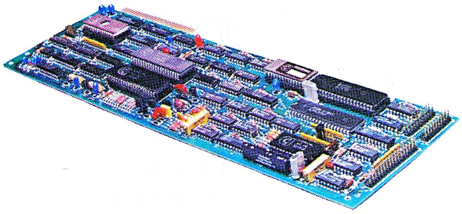

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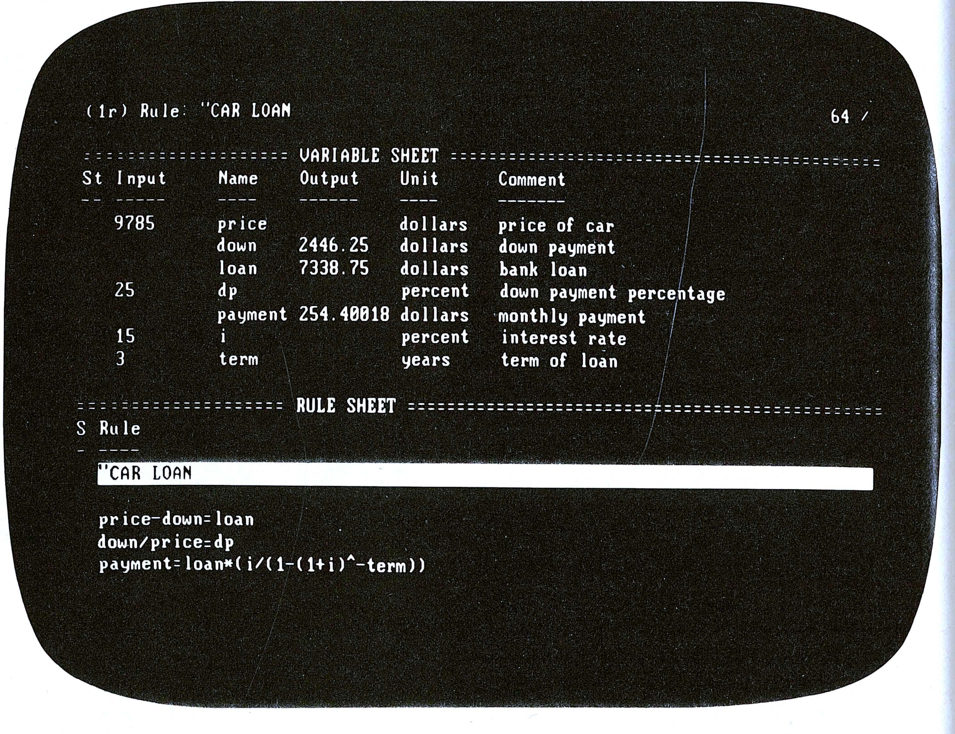

```
(1r) Rule: "CAR LOAN                                                   64 /

==================== VARIABLE SHEET ===========================================
St Input     Name    Output    Unit     Comment
-- -----     ----    ------    ----     -------
   9785      price             dollars  price of car
             down    2446.25   dollars  down payment
             loan    7338.75   dollars  bank loan
   25        dp                percent  down payment percentage
             payment 254.40018 dollars  monthly payment
   15        i                 percent  interest rate
   3         term              years    term of loan

==================== RULE SHEET ===============================================
S Rule
- ----
 "CAR LOAN

 price-down=loan
 down/price=dp
 payment=loan*(i/(1-(1+i)^-term))
```

Equation processing with TK!Solver, or problem solving made easy. The best way to understand what the TK!Solver program *is*, is to understand what it *does*. The following simple example is designed to do just that. If you're still a little in the dark after reading it, stop in at your local computer store for a very enlightening hands-on demonstration.

Begin by setting up your problem. The TK!Solver program lets you do it quickly, easily, and naturally. For example, a car costs $9785. What would be the monthly payment on a three-year loan if the down payment is 25% and the interest rate is 15%?

STEP 1. Formulate the necessary equations to solve your problem and enter them on the "Rule Sheet" simply by typing them in (as in the screen photo). For example: "price—down = loan."

STEP 2. Enter your known values the same way on the "Variable Sheet." For example: "9785" for price. You may also enter units and comments, if you want.*

STEP 3. Type the action command ("!" on your keyboard) to solve the problem.

STEP 4. TK!Solver displays the answer: the monthly payment is $254.40.

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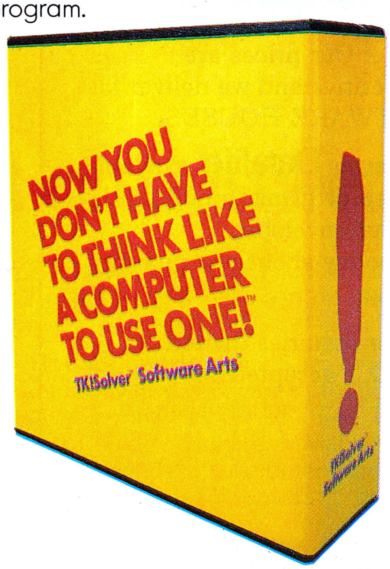

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P/N 100-092 P 8/83

ber of potential users is near the capacity of the network server.

Summary

In this series, we have taken a good look at currently available local area networks for the pc. New networks may differ in detail from the three reviewed here; however, the ability of a network to support file transfer, disk and printer sharing, and concurrent access should be closely examined before significant resources are committed to the system. The availability of application software that can take advantage of network features (concurrent-access databases, for example) should also be determined.

In the course of examining these three networks, we've been able to identify some similarities and differences among them. Table 4 summarizes the salient features of the three networks. The intent here is not to show one network as being "best" in all situations, but rather to illustrate that each of these systems may be the best for a given set of circumstances.

The strengths of the *PCNet I* system are its ease of use and simplicity of configuration. *Omninet* excels in terms of flexibility; it permits you to connect dissimilar computers and operating systems, and it allows you, at relatively low cost, to add workstations to the net. *EtherLink* has the advantage of its compatibility with standard Ethernet components and networks. ▲

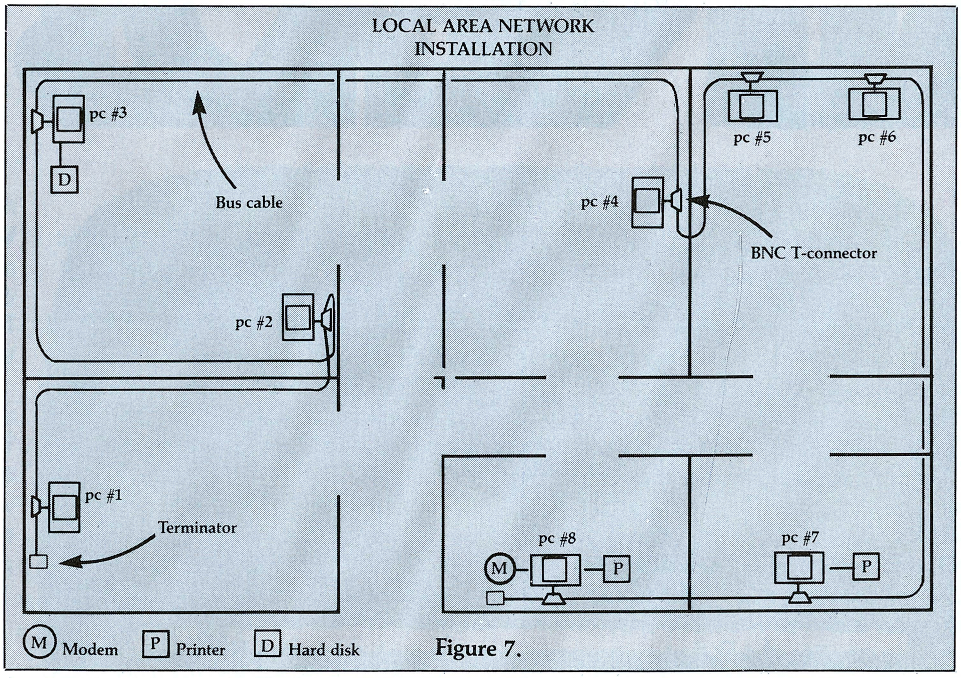

Figure 7.

Summary of Network Features

Feature	PCNet I	Omninet	EtherLink
Transmission media	Coaxial	Twisted pair	Coaxial
Adapter cost	$695	$495	$950
Cable cost	$0.16/ft	$0.08/ft	$20+$1/meter
Access protocol	CSMA/CD	CSMA	CSMA/CD
Higher protocol	No	Layers 3/4	No
Max length (ft)	3000/7000	4000	300 m-2.8 km
Servers	No	Yes	Yes
Multiple OS	No	Yes	No
Multiple computers	No	Yes	No
Data rate	1 Mbit/sec	1 Mbit/sec	10 Mbit/sec
No. of devices	64,000	64	1,024
Gateways	Future	Future	Repeater
Printer sharing	Yes	Yes	Yes
Bandwidth	Baseband	Baseband	Baseband
Topology	Distributed bus	Distributed bus	Distributed bus
Concurrent Access	Record level	File level	By volume
Multiuser OS	No	No	No

Table 4.

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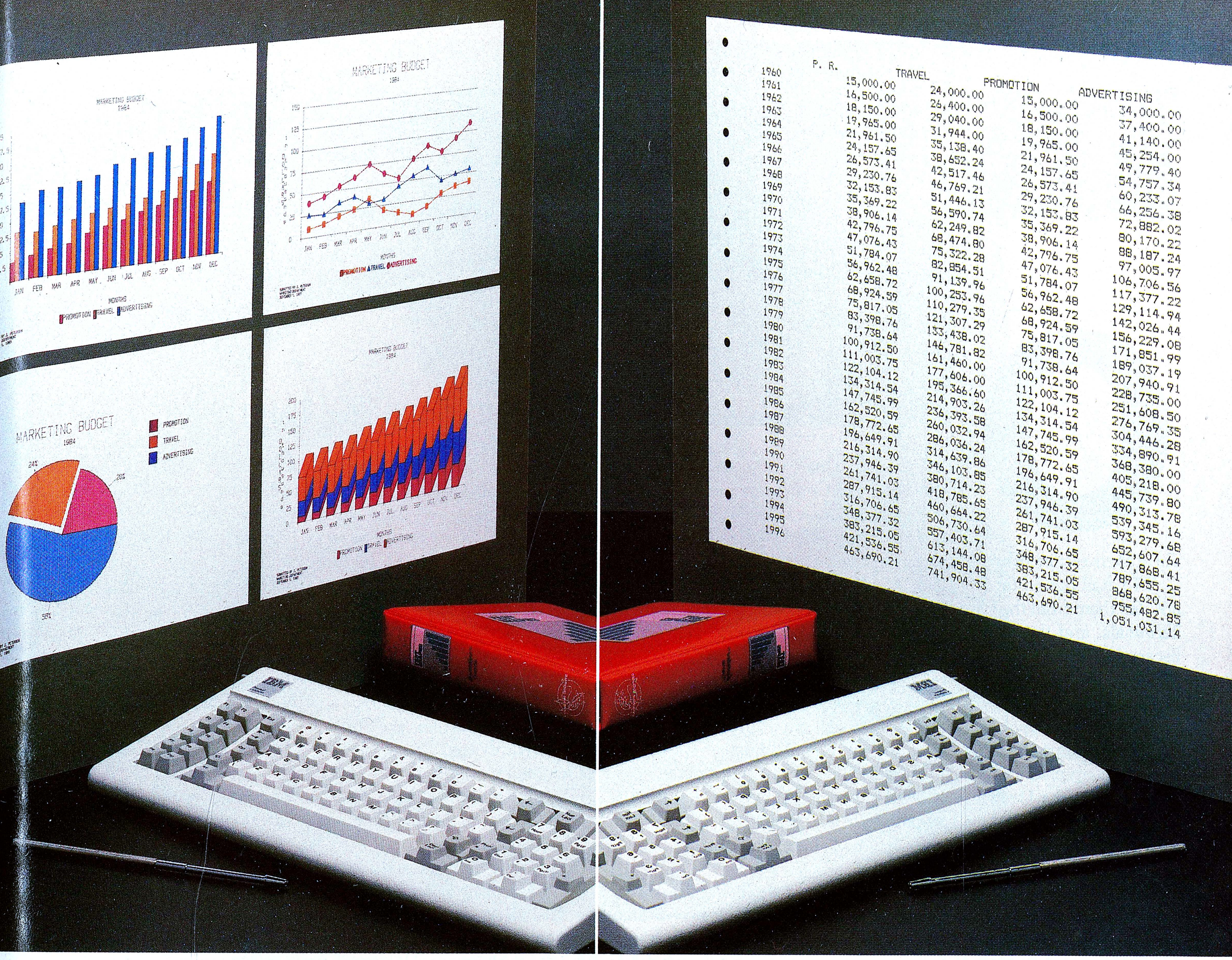

```
        P. R.        TRAVEL       PROMOTION     ADVERTISING
1960    15,000.00    24,000.00    15,000.00     34,000.00
1961    16,500.00    26,400.00    16,500.00     37,400.00
1962    18,150.00    29,040.00    18,150.00     41,140.00
1963    19,965.00    31,944.00    19,965.00     45,254.00
1964    21,961.50    35,138.40    21,961.50     49,779.40
1965    24,157.65    38,652.24    24,157.65     54,757.34
1966    26,573.41    42,517.46    26,573.41     60,233.07
1967    29,230.76    46,769.21    29,230.76     66,256.38
1968    32,153.83    51,446.13    32,153.83     72,882.02
1969    35,369.22    56,590.74    35,369.22     80,170.22
1970    38,906.14    62,249.82    38,906.14     88,187.24
1971    42,796.75    68,474.80    42,796.75     97,005.97
1972    47,076.43    75,322.28    47,076.43    106,706.56
1973    51,784.07    82,854.51    51,784.07    117,377.22
1974    56,962.48    91,139.96    56,962.48    129,114.94
1975    62,658.72   100,253.96    62,658.72    142,026.44
1976    68,924.59   110,279.35    68,924.59    156,229.08
1977    75,817.05   121,307.29    75,817.05    171,851.99
1978    83,398.76   133,438.02    83,398.76    189,037.19
1979    91,738.64   146,781.82    91,738.64    207,940.91
1980   100,912.50   161,460.00   100,912.50    228,735.00
1981   111,003.75   177,606.00   111,003.75    251,608.50
1982   122,104.12   195,366.60   122,104.12    276,769.35
1983   134,314.54   214,903.26   134,314.54    304,446.28
1984   147,745.99   236,393.58   147,745.99    334,890.91
1985   162,520.59   260,032.94   162,520.59    368,380.00
1986   178,772.65   286,036.24   178,772.65    405,218.00
1987   196,649.91   314,639.86   196,649.91    445,739.80
1988   216,314.90   346,103.85   216,314.90    490,313.78
1989   237,946.39   380,714.23   237,946.39    539,345.16
1990   261,741.03   418,785.65   261,741.03    593,279.68
1991   287,915.14   460,664.22   287,915.14    652,607.64
1992   316,706.65   506,730.64   316,706.65    717,868.41
1993   348,377.32   557,403.71   348,377.32    789,655.25
1994   383,215.05   613,144.08   383,215.05    868,620.78
1995   421,536.55   674,458.48   421,536.55    955,482.85
1996   463,690.21   741,904.33   463,690.21  1,051,031.14
```

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The Printed Word

by John Dickinson

The Intelligent Printer, Part II

Once upon a time there was a great Kingdom in the World of Computers named ASCII. The King was a wise man named aSC who had earned his position by leading his people in their escape from the chains of their previous leader, TTY.

TTY had bound the people of ASCII to the World of Teleprinters. aSC led them from the World of Teleprinters to the World of Computer Terminals, and thence to the great World of Computers. This Great Escape had brought unity and peace to the Kingdom of ASCII.

There were two nations in the Kingdom of ASCII. One was in the HardLands and was populated by the HardWares. The other, in the SoftLands, was populated by the SoftWares. The HardWares and the SoftWares communicated using the common language of ASCII, which had originally been invented by TTY. One of aSC's greatest contributions to the lifestyle of the Kingdom was his extension of the ASCII language to include lower-case letters. To honor this contribution the people of ASCII always spelled aSC's name starting with a lowercase letter.

The two nations communicated and got along well using the ASCII tongue. Many of the HardWares and SoftWares got along so well that they married, producing HardSoftWare and SoftHardWare offspring. This presented few problems, as offspring of this hybrid type were thought to strengthen the breed in the World of Computers.

The workaday lifestyle of the HardWares included processing the data in their memory banks, operating video displays, running disk drives, and printing reports. The SoftWares had the job of providing instructions to the HardWares to tell them how and when to do their work. The HardWares also had the job of providing the SoftWares with places to live and work; so, you see, the relationship was mutually beneficial.

As with any family of nations, there were some disagreements. One of them was the rather pleasant wrangle of deciding how to celebrate the Great Escape of the ASCII people from the chains of TTY. On one point they all agreed: The date of freedom was the Twenty-Seventh Day of the Twenty-Seventh Month of the Twenty-Seventh Year of the Twenty-Seventh Century of the Twenty-Seventh Aeon in the history of the World of Computers. (In case you're wondering, an aeon in the World of Computers is about the same length of time as a day is in the Human World.)

They all agreed on one or two other points about the event as well. The letter marking the day should be the Character Number Twenty-Seven in the alphabet of the language of ASCII (there were two hundred fifty-six characters in all). With so many twenty-sevens in the historical date, who could disagree? They also agreed to call the twenty-seventh character Escape, meaning that it should mark the Great Escape from the chains of TTY.

The disagreement came over how the twenty-seventh character should be displayed. "We can't just use the word Escape. That has six characters, and there must be only one character," said the SoftWares.

The HardWares agreed. "We should show the Escape by leaving what we're doing and doing something else." They added, "We could make a key with the word Esc on it. That way when it is pressed, we'd all know to leave what we're doing."

That seemed like a fine idea to the SoftWares. "We'll just leave what we're doing too. How symbolic, to Escape from the chores of telling you HardWares what to do!"

The only problem was that if the SoftWares left what they were doing, they couldn't tell the HardWares what to do. If the HardWares left what they were doing, there was little chance they would pay attention to the instructions the SoftWares gave them.

The HardWares had a solution. "We'll hold a special event instead of just doing nothing," they said.

"Sure," said the 8088s, "we'll have the 8087s do their special tricks when we see the Escape. That'll be something to see!"

The printers concurred. "Why, we can make magic happen when we see the Escape. We'll make different fonts, turn on the underscore, darken the print, change the page length. You name it, we'll do it!"

This all seemed quite marvelous—such entertaining tricks in celebration of the Great Escape!

"The heck you say! We're just going to take some time off," said the SoftWares. "It's supposed to be a holiday. If you folks want to entertain the crowds, that's your business."

This was, indeed, quite an impasse. Much arguing took place, and finally aSC himself was asked to step in to settle the dispute. Being the wise and good man that he was, he said, "I need a consultant to help out here. I'm too old to settle disputes like this by myself."

It had long been rumored in the Kingdom of ASCII that there were Oracles to be found in the City of Armonk in the neighboring Kingdom of EBCDIC. "Perhaps," aSC thought, "they will be able to help me out." So aSC journeyed the long distance to the City of Armonk to consult the Oracles there.

"They are both right," said the Oracles, for they were wise consultants. "You should seek a compromise amongst the squabblers. The Linguists of your Kingdom can help you find one."

aSC journeyed back to ASCII feeling that he had the answer. The Linguists, you see, were a special clan in the SoftLands who could communicate with both the SoftWares and the HardWares under even the most catastrophic conditions. Ordinary SoftWares used the Linguists in their work, but often did not take advantage of their great powers. The results were sometimes embarrassing to aSC.

Upon his return aSC called all the Linguists together. "Everyone wants to celebrate the Escape in his or her own way," he told them, "and I need some help from you to pull things together."

Basic looked at the problem for a moment. "Trivial," he said. "All we have to do is send the HardWares a CHR$(27), and they'll know to put on their special shows."

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3) Print Document Utility
4) Printer Control Utilities
5) Merge Print Utility
6) Document Handling Utilities
7) Other Utilities
9) Return to DOS
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Enter the number
tion, press RETURN

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while others
have visions.

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"What about the SoftWares?" said aSC.

"No problem. When the Escape Key is pressed I'll just let the SoftWares jump off line until someone tells them that the holiday is over."

Assembler agreed. "Look, just MOV a 27 into a register and tap the HardWares on the shoulder with an INT. They'll know what to do. The SoftWares won't care, and we'll just do whatever they ask with their Escape."

Pascal was miffed. "After I did all that work to provide a built-in chr variable, you have to ask what to do? And the time I spend compiling it? Hmmph!"

And so it was that the Linguists agreed on how to solve the problem for aSC. "What about our Human users?" he asked.

"Well, Basic here seems to be the most available of the Linguists," said Assembler. "He's always hanging around the ROM chips, and he's quite good at interpreting things for people."

"I guess you have the easy answer, then, Basic," said aSC. "I just hope you other Linguists can help out when the time arrives." Fortran left the room in a quiet sulk.

And so it was that the Great Escape dispute was resolved. If Human computer users are willing to call on the Linguists, they can watch their HardWares celebrate the Escape in all the ways they provide.

I tell this little fable not just because it's probably a cold November night where you live. I tell it because for the life of me I cannot figure out how else such a crazy situation could have occurred on the pc.

Here you have a solid, reliable microcomputer (the pc), with a good operating system (PC-DOS), and an excellent selection of compatible printers to choose from. Yet there is no simple way to use the printers! It's easy enough to make them print ordinary text characters; making them do their "special shows" by using their built-in features and options is altogether another matter.

Last month's column covered the simple feat of printing some characters and issuing line feeds, carriage returns, and form feeds. You turned your pc and a printer into a typewriter by using the PC-DOS copy command.

If you recall, the characters and commands sent to the printer were defined as ASCII codes. The printed characters each had a number in the ASCII code sequence, as did the line feeds, carriage returns, and form feeds. Each printed character was in the normal printable ASCII range of character 032 (blank) through character 126 (tilde), and the action codes, such as line feed, had codes below 032 (010 for line feed, 013 for carriage return, and 012 for form feed).

When a printer is required to take a nonprinting action, it must be sent some sort of code having the following two characteristics:

- It is not a printable code.
- It has meaning to the printer's computer.

The codes for line feed, and so on, fall below 032 and therefore meet the first criterion—they are not printable codes. They are also universally defined among printers to have exactly the same meaning and therefore meet the second criterion.

You were able to tell your printer to use these codes by using the PC-DOS *copy* command just as if the codes had been printable characters. The carriage return and line feed codes were automatically generated by the pc's enter key, and we were able to generate the form feed using the alternate key in combination with the pc's numeric keypad. This worked fine for these well-defined action codes, but if you wish to explore your printer's intelligence further, you must step into the strange world of escape sequences.

If you go back to the September issue you can review the rather large group of nonprinting features available on the Epson MX-80 (with Graftrax-Plus) Printer and its IBM Personal Computer Graphics Printer cousin. How can we define nonprinting codes for all of those features and options using just the thirty-two numbers (000—031) available below the printable range of ASCII codes?

One answer might be to use the character codes above ASCII 126. This would not be satisfactory for two reasons: First, many microcomputers for which ASCII printers are designed (Apple II and TRS-80, for example) are unable to send codes to the printer with values greater than 127 (they only send seven bits instead of the eight sent by the pc). Second, restricting such a wide range of codes to nonprinting status would cripple the ASCII code standard's ability to expand, for example, into international character sets. (Remember that part of aSC's reputation as a wise leader stemmed from his introduction of lower-case letters into the ASCII language.)

The alternative is to define one character as the character that tells the printer to stop printing characters and do something else, in this case to make use of one of its features or take some other nonprinting action. This has been the method of choice in the design of most features of most pc-compatible ASCII printers. The character usually chosen, of course, has been the escape character, which is number 027 in the ASCII code sequence. The code sequences used to enable and disable printer features have become known as "escape sequences," since they almost always start with the escape character.

Look at the table from the September column once more. Roughly 90 percent of the code sequences in Basic notation start with *chr$(27)*, Basic's version of the escape character. In fact, the names of most entries in the table start with Esc.

In the IBM pc environment the escape key, which is also defined as character 27 in the ASCII code sequence, is used by most software packages, including PC-DOS itself, to mean "Leave whatever you're doing and throw the previous work away." IBM's *Software Submission Guide* suggests that software authors "design . . . so that users can backtrack or exit from a program or safely cancel it using the escape

MUNCH $29.95

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- Requires an IBM with 64K, 1 disk drive, color/graphics, joystick optional.

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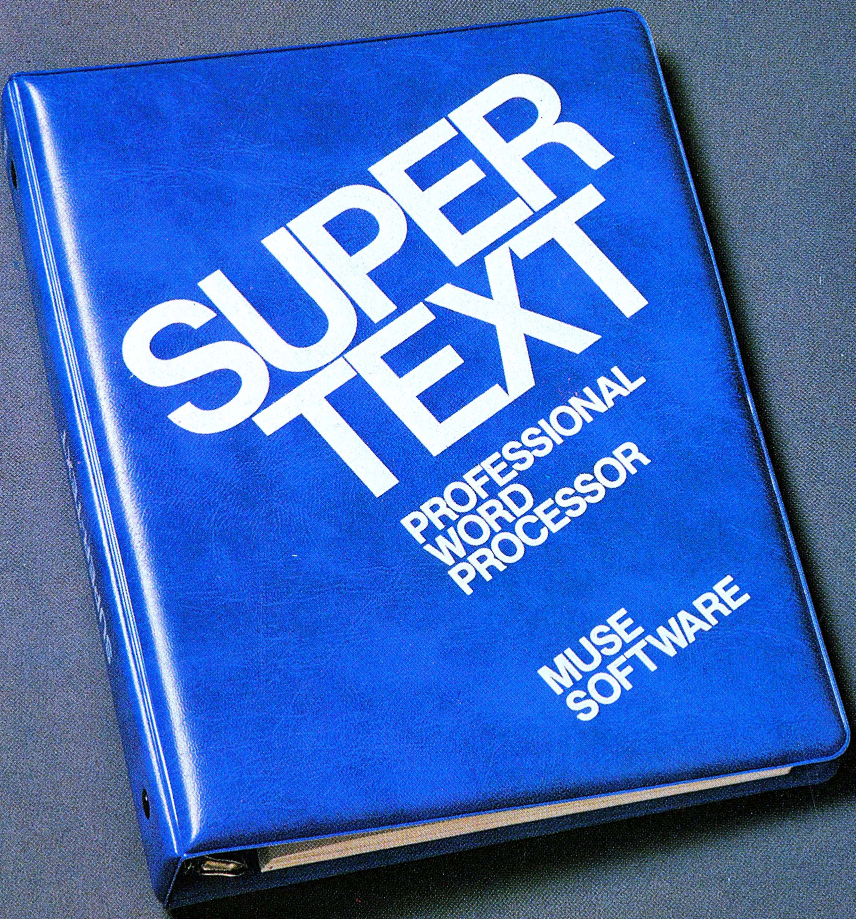

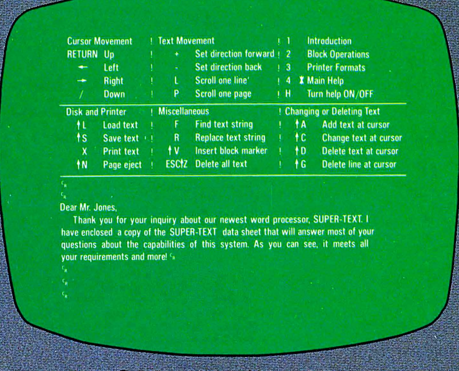

```
Cursor Movement    ! Text Movement                ! 1     Introduction
RETURN  Up         !    +    Set direction forward ! 2     Block Operations
  ←     Left       !    -    Set direction back    ! 3     Printer Formats
  →     Right      !    L    Scroll one line'      ! 4   ⧗ Main Help
  /     Down       !    P    Scroll one page       ! H     Turn help ON/OFF
-------------------------------------------------------------------------
Disk and Printer   ! Miscellaneous                ! Changing or Deleting Text
  ↑L    Load text  !    F    Find text string      !   ↑A   Add text at cursor
  ↑S    Save text  !    R    Replace text string   !   ↑C   Change text at cursor
   X    Print text !   ↑V    Insert block marker   !   ↑D   Delete text at cursor
  ↑N    Page eject ! ESC↑Z   Delete all text       !   ↑G   Delete line at cursor
-------------------------------------------------------------------------
␍
␍
Dear Mr. Jones,
   Thank you for your inquiry about our newest word processor, SUPER-TEXT. I
have enclosed a copy of the SUPER-TEXT data sheet that will answer most of your
questions about the capabilities of this system. As you can see, it meets all
your requirements and more! ␍
␍
␍
␍
```

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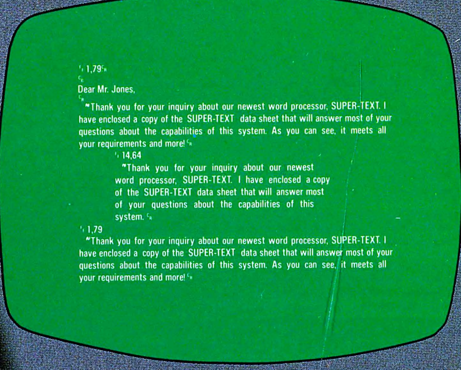

```
' 1,79␍
␍
Dear Mr. Jones,
␍
  "Thank you for your inquiry about our newest word processor, SUPER-TEXT. I
have enclosed a copy of the SUPER-TEXT data sheet that will answer most of your
questions about the capabilities of this system. As you can see, it meets all
your requirements and more! ␍
          ' 14,64
            "Thank you for your inquiry about our newest
          word processor, SUPER-TEXT. I have enclosed a copy
          of the SUPER-TEXT data sheet that will answer most
          of your questions about the capabilities of this
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' 1,79
  "Thank you for your inquiry about our newest word processor, SUPER-TEXT. I
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key (Esc)." Most pc programs do this, or something close to it.

However closely software packages follow IBM's guidelines, none of them (with the exception of a special feature in the IBM *Personal Editor*) allows you simply to enter an escape character into your data. (Feel free to send in references to any pc software that does allow direct entry of the escape character—we'd like to know about them!)

Let's go back to the *copy* command typewriter environment we used last month. Remember, at the PC-DOS prompt type:

```
A>COPY CON: LPT1:
```

Your cursor will be positioned on the video display to receive data just as it was last month. Type *the quick brown fox,* or whatever else you wish. This time, however, press the escape key at some point while you're typing or after you've typed the line. The result will look something like this:

```
A>COPY CON: LPT1:
The quick brown fox jumped over the lazy yellow\
dog.
```

Notice the backslash. It was placed there by PC-DOS when you pressed the escape key. At that point the first line was completely canceled by PC-DOS. (Remember, PC-DOS is one of the SoftWares who celebrate the Great Escape by quitting.) When you press the F6 key to close the Con: file, your printer will start chattering away as it did last month. This time, however, only the second line will be printed. The first line is gone! (By the way, you won't have this problem if you type a backslash into your text. The backslash key has no relationship to the escape key.)

When you press the escape key in PC-DOS, Basic, Edlin, or most other PC-DOS-compatible software environments, whatever you are doing will be stopped, and whatever you did will be gone. (The IBM *Personal Editor* is an exception to this.)

Let's define a problem requiring an escape sequence to be sent to the printer and try to solve it in the pc environment. You'll have to go to the Linguists for help, but remember, they promised aSC that they would help you. Don't worry if you don't know how to talk to them (program). We'll get you through it.

Suppose you want to print the word *Softalk* on your printer using an enhanced print mode. These modes, which darken the characters, are usually called emphasized, double-strike, boldface, or shadow printing. Just about all printers having this feature use an escape sequence to enable enhanced printing modes.

You might remember from last month that printing *Softalk* normally requires the following ASCII code sequence:

```
083 111 102 116 097 108 107 013 010
```

By using the PC-DOS *copy* command you were able to send this sequence to your printer and have it print *Softalk* followed by a carriage return and a line feed.

The emphasized print mode on all IBM and Epson printers is defined by the following escape sequence:

```
027 069
```

The Texas Instruments 850 printer uses the same escape sequence. Other makes and models use different sequences for enhanced printing. The C. Itoh Prowriter uses 027 033 for boldface, and the Okidata Microline 92 uses 027 072 for emphasized print. The NEC 3550 uses 027 069, and the Diablo 630 uses 027 079 to enable their boldface print modes. Consult your printer manual if you have a different make or model.

Printing *Softalk* in emphasized print mode on an Epson, IBM, or TI 850 printer requires the following ASCII code sequence, including the escape sequence (underlined portion; substitute the correct escape sequence for your printer):

```
027 069 083 111 102 116 097 108 107 013 010
```

Notice that the escape sequence precedes the rest of the ASCII code sequence required to print *Softalk* and issue the carriage return and line feed. This enables the emphasized printing mode, and all subsequent printing occurs in this mode. The escape sequence that enables the emphasized mode has no effect on the printer's ability to perform carriage returns and line feeds.

You may remember that any nonprinting code that doesn't appear on your pc's keyboard (such as 012, the form feed) can be entered by means of the alternate key combined with the number keys on the numeric keypad. This works for all codes except ASCII 027, the escape code. Whether you use the escape key or the alternate-numeric keypad combination, PC-DOS will quit whenever the escape code is entered. Yet our ASCII code sequence requires the escape code. It's time for the Linguists to step in!

All pcs come equipped with the Basic language installed in the hardware, so selecting a Linguist to help out here isn't much of a problem. Load your working copy of PC-DOS (be sure it includes the Basic.com or BasicA.com file) in drive A. Load a formatted scratch disk in drive A. Log on to drive B by typing:

```
A>B:
```

PC-DOS will respond by prompting you with a B> instead of an A>. Now you're ready to start Basic. From the PC-DOS prompt type:

```
B>A:BASIC
```

or

```
B>A:BASICA
```

(If you have a single disk drive system, don't bother logging on to drive B. Just insert your scratch disk in the disk drive after Basic starts.)

Either the Basic or BasicA version of Basic will work fine. When Basic starts, there will be some messages, and then the word Ok will appear somewhere near the top of your screen. The bottom row of your display will show the function key definitions (see your Basic manual for details; the function keys won't be needed here).

From the Basic Ok prompt, type:

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```
AUTO
```

This will start Basic's automatic input mode. The number 10 will appear on the left of your screen. As each line number appears, type in the following program:

```
10 OPEN "ESCAPE.ASC" FOR OUTPUT AS #1  ' Open Escape.asc
20 PRINT #1, CHR$(27);                 ' Escape character
30 CLOSE #1                            ' Close the file
40 SYSTEM                              ' Back to PC-DOS
```

When the number 50 appears, hold down the control key and press the break key (the one marked Scroll Lock). This will end Basic's automatic input mode. List the program on your screen by typing *list* after the Ok prompt. If you've made any mistakes, simply retype the line, including the line number on the left. This will replace the line. List the program again to be sure everything is correct.

What this program will do is write a small (one-character) ASCII file on your B disk (remember to make it a scratch disk) containing the escape character. We've named it Escape.asc to remind you of what it contains and that it is an ASCII format file. Please be sure to enter the semicolon into your program following the *chr$(27)*. This tells Basic that you don't want a carriage return and line feed inserted into your Escape.asc file.

To run the program, type *run* or press the F2 key, which does the same thing in Basic. When the program ends, you will return to PC-DOS with the familiar B> prompt on your screen. Now you're ready to send an escape sequence to the printer!

The PC-DOS *copy* command includes a feature allowing you to append one file to another. The command for appending File1 to File2 and putting the results into File3 is:

```
B>COPY FILE1+FILE2 FILE3
```

Using the *copy* command to make your pc into a typewriter is no different from appending one file to another. Just use the reserved file names you've already learned (Con: and Lpt1:) and the name of another file. In this case we'll use the Escape.asc file we've just created. Remember that the first character needed in the required ASCII sequence is the escape character. The rest, including the 069 required for emphasized print, are in the printable range of the ASCII code (069 is capital E), and are therefore available on our keyboard. You could, of course, type them all using the alternate keys and the numeric keypad.

So, to print *Softalk* with emphasized printing, type the following:

```
B>COPY ESCAPE.ASC+CON: LPT1:
ESoftalk
```

Press F6 as before and your printer will type *Softalk* in emphasized print.

You could just as well have included the E in the Escape.asc file. But that might have limited the file's use. For example, if you want to print something else in normal printing mode, you have to disable the emphasized print mode. How? Most printer features can be disabled as well as being enabled. In this case, emphasized print is disabled with the escape sequence:

```
027 070
```

ASCII code 70 is capital F. To disable emphasized print and have the printer type the rest of our magazine's title, type:

```
B>COPY ESCAPE.ASC+CON: LPT1:
Ffor the IBM Personal Computer
```

Once again, press the F6 key to close the Con: file and the printer will start printing. This time it will print normal characters. You could have disabled the emphasized print by switching the printer off and then on again, but that wouldn't have been as much fun!

Last month we began to write a hypothetical Pascal program that could theoretically run our intelligent printer's computer. Before ending for the month we should update the program. When we left off last month it looked like this:

```
if character_code >= 32 and character_code <=127
then printable_code := true
else printable_code := false;
if printable_code then print_a_character (character_code)
else if [character_code = 007
or character_code = 008 or character_code = 009
or character_code = 010 or character_code = 011
or character_code = 011 or character_code = 013
or character_code = 024]
 then take_an_action (character_code);
```

Remember that *character_code* is the ASCII code sent from the computer to the printer; *printable_code* is a Boolean expression that is true or false, depending on the value of *character_code*; *print_a_character* and *take_an_action* are procedures that were defined in last month's column.

For now we'll add just one line:

```
else if character_code = 027 then escape;
```

The new procedure *escape* is also defined elsewhere. Its purpose is to process the escape sequence sent from the computer and to take the action specified by that sequence.

More about that in a later issue. For now, enjoy your turkey! ▲

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marketalk news

Δ Fully compatible with the Unix Version 7 C language standard, *Digital Research C* is a full-featured standard C programming language compiler. From **Digital Research** (Box 579, Pacific Grove, CA 93950; 408-649-5500), the software features multiple memory model, chaining support, and extensive compiler command line option switches. Requires 112K. $350. Δ *Dr. Logo* is an advanced version of Logo, the educational graphics language, written in C. The self-contained programming environment includes its own operating system, editing and debugging features, and turtle graphics cursor. *Dr. Logo* supports double-precision floating-point mathematics and requires graphics adapter and 192K. $149.95.

Δ A pocket-sized guide to software for the pc is available from **UOI Company** (15445 Ventura Boulevard, Sherman Oaks, CA 91413; 213-785-5050). The *Software Plus Buying Guide* describes software by key features. Contains a search service and references to published reviews. $2.

Δ A Farm Computer section comprising more than forty exhibit booths will display agricultural software and hardware for problem solving, information retrieval, and agriculture/farm office management at the Eighth Annual Southern Farm Show. The show takes place February 1—3, 1984, at the North Carolina State Fair Grounds in Raleigh. A series of miniseminars is also planned. Sponsored by **Southern Farm Show** (Box 36859, Charlotte, NC 28236; 704-376-6594).

Δ **Comshare** (3001 South State Street, Ann Arbor, MI 48106; 313-994-4800) has introduced the Target line of decision-support software, including *Target Financial Modeling,* a two-window model manipulator that uses either the spreadsheet or command file method. Requires 128K. $325.

Δ New releases from **CBS Software** (One Fawcett Place, Greenwich, CT 06836; 203-622-2620): *Charles Goren: Learning Bridge Made Easy* is a tutorial developed by the internationally known master. Teaches both bidding and play of the hand. $79.95. Δ *Match-Wits* is a game of memory, logic, and strategy for one to four players. First to uncover a picture puzzle wins. $29.95. Δ *Mystery Master: Murder by the Dozen* is a logic and deduction game that challenges the player to unravel twelve murder cases in the city of Micropolis. Map included. $34.95. Δ *Mastering the College Board Achievement Tests: English Composition* is a tool for student review. Offers problems and pointers. $175. Δ *Mastering the SAT* prepares students for the Scholastic Aptitude Test and includes practice in all skill areas. $150.

Δ Link application programs together with a system-building tool called *Starburst* now available from **MicroPro International** (33 San Pablo Avenue, San Rafael, CA 94903; 415-499-1200). Create custom menus and help messages using a *WordStar*-like text editor. Twenty-four simple one-key commands help automate tasks for your custom system. As many as one hundred lines of task commands can support each menu choice. $195.

Δ **IBM Direct Education** (909 Third Avenue, New York, NY 10022; 800-631-5582) offers a series of Information System Management Institute seminars around the country until mid-December. Topics include data security planning, managing data processing, application backlog management, project implementation, and twenty-three others. Seminars range from two to five days each and tuition includes course material and computer time if used. Call for information.

Δ The Benchmark system is a collection of routines that use applied geometry to solve land-surveying and civil-engineering problems. From **The Coppersmith** (143 Kimball Hill Road, Hudson, NH 03051; 603-889-2670). Programs include *Traverse Boundary, Coordinate Geometry,* and cul-de-sac, street intersection, and lot design utilities. Requires two disk drives. $1,500.

Δ *Megawriter* is a low-priced word processor that features a mail merging function and full eighty-column screen. From **Megahaus** (5703 Oberlin Drive, San Diego, CA 92121; 619-450-1230), the package can move and copy almost unlimited text at one time and prints documents with boldface, underlining, and so on. Menu-driven. $99.95.

Δ The object of the arcade-style game *J-Bird* is to outwit and outmaneuver the critters chasing you as you hop among the cubes of a 3-D pyramid. From **Orion Software** (Box 2488, Auburn, AL 36831; 800-821-8088), the game includes a two-player mode, multiple play levels, and joystick option. Requires color/graphics adapter. $36.95.

Δ **Ariel** (600 West 116th Street, New York, NY 10027; 212-662-7324) has introduced the Ariel RTA 331, a one-third-octave real-time audio frequency spectrum analyzer that plugs into a single expansion slot. The board divides the audio spectrum into thirty-one third-octave bands from twenty Hz to twenty kHz and interactively displays the relative amplitude of each band. Several other features included. $649.95.

Δ A five-and-one-quarter-inch floppy disk controller designed for use with the Faraday model FE 64 CPU board has been introduced by **Faraday Electronics** (1029 Corporation Way, Palo Alto, CA 94303; 415-961-0600). The model 514 board controls from one to four single- or double-sided disks. $135.

Δ Emulation software is now available from **Interlan** (3 Lyberty Way, Westford, MA 01886; 617-692-3900). The *Poly-TRM* package can issue commands to a Interlan NTS10 Terminal Server to request a virtual circuit connection over the network to the desired EIA RS-232-C target device. Files can be transferred to and from the target device. $150. Δ *Poly-XFR* is a program that provides error-free transfer of binary and ASCII files over Ethernet. $150. Δ *Poly-Com* is both packages combined. $200.

Δ *The Reference Encyclopedia for the IBM Personal Computer* has been published by **Ashton-Tate** (10150 West Jefferson Boulevard, Culver City, CA 90230; 213-204-5570). The one-thousand-page encyclopedia-style sourcebook, by Gary and Karen Phillips, contains more than forty-three hundred entries on a variety of pc-related subjects. Computer terms, functions, product details, and programming tips are indexed and cross-referenced. Two volumes, hardcover. $69.95.

Δ **Emerging Technology Consultants** (2031 Broadway, Boulder, CO 80302; 800-782-4896) has introduced *Offix,* a filing, word processing, forms design, and report-generating package. Pop-up menus and on-line documentation make the personal office system easy to learn and use. Requires 128K and two disk drives. $99. Δ *Wordix* is a word processor that offers a macro-instruction capability, string variable and numeric variable assignments, and a set of integer arithmetic operators. Requires 96K. $195. Δ *Spellix* is a spelling checker with a forty-three-thousand-word dictionary. Requires 96K. $95.

Δ *Screen* is a full-screen text editor from **Basic Business Software** (Box 26311, Las Vegas, NV 89126; 702-876-9493). Features full-screen cursor movement (line lengths of up to two hundred forty characters); horizontal scrolling; and block move, copy, and delete. $5 for disk. $35 for documentation and latest release if satisfied.

Δ The second edition of *The Microcomputer Marketplace* is available from **Dekotek** (2248 Broadway, New York, NY 10024; 212-799-6602). More than ten thousand companies are listed, with in-depth profiles on each. Includes software publishers, distributors, magazines and newsletters, database publishers, and more. The cross-indexed volume also contains a month-by-month calendar of one hundred sixty-five industry meetings and details on each. $59.

Δ A consumers' guide to the pc/XT and compatible software, called *The Book of IBM Software 1984,* has been introduced by **The Book Company** (11223 South Hindry Avenue, Los Angeles, CA 90045; 213-410-9466). Features *Consumer Reports*-style reviews of business, personal, educational, utility, and game software. Programs are graded from A to F, based on ease of use, vendor support, error handling, and so on. $19.95.

Δ **Taurus Software** (3685 Mount Diablo Boulevard, Lafayette, CA 94549; 415-283-7222) has announced *CP+* Version 2.0, a combination package featuring a tutorial on the basic uses of the personal computer, an English front-end interface, and a package of file utilities. New feature is *Start+*, a menu-building facility. $200.

Δ A word processing system that has a built-in ability to integrate with the company's full line of accounting software has been introduced by **State of the Art** (3183-A Airway Avenue, Costa Mesa, CA 92626; 714-850-0111). Information from accounts receivable, payable, and billing can automatically be inserted into form letters and reports. $395.

Δ *The BPI Church Management System* enables the small- to medium-sized church or synagogue to do accounting and record keeping on the pc. Includes family and member record keeping, income accounting, mailings to the entire congregation or selected groups, and letter writing. Creates deposit registers from entered contributions and analyzes budget projections. Requires two disk drives (for up to twelve hundred members) or hard disk (six thousand members). $795. Δ *BPI Association Management* allows organizations to do accounting, record keeping, and word processing. Spreadsheet for up to ten different projects included. Requires two disk drives (one thousand members) or hard disk (up to five thousand). $795. Δ *BPI Personal Accounting* is a home system that lets you define assets, liabilities, net worth, income, and so on. The system also plans your budget and prints checks. Requires two disk drives. From **BPI Systems** (3423 Guadalupe, Austin, TX 78705; 512-454-2801). $195.

Δ *Windrive*, from **Tall Tree Systems** (1032 Elwell Court, Palo Alto, CA 94303; 415-964-1980), is software support for add-on hard disk systems. The package divides up the hard disk by creating individual volumes; a total of thirty-three volumes can be created. A menu-driven program selects the volume organization that suits your needs. Runs under both DOS 1.1 and 2.0. $40.

Δ A comprehensive client information and money-management database system has been released by **IMSI** (Box 2643, San Anselmo, CA 94960; 415-454-7101). *Bisybase* can be used as an activity planner as well as a financial planner. Foreign currency conversions are handled automatically. Compatible with five popular word processing programs. $275.

Δ Upload and download information on the Techland 4341, 3033, and 3081 with version 1.07 of *Blue Lynx.* The micro-to-mainframe communication package has been released by **Techland Systems** (25 Waterside Plaza, New York, NY 10010; 212-684-7788). *Blue Lynx* features a simplified configuration routine that makes installation easier. Hardware and software: $690.

Δ Repair shops, computer stores, and serious users can check the alignment and operation of a floppy disk drive using *ReadiScope*, diagnostic software from **ReadiWare Systems** (Box 680, West Redding, CT 06896; 203-431-3521). Proper overall operation of the drive may also be determined and alignment may be accomplished without special tools. $295.

Δ Interactive tutorials designed to help the user maximize the potential of *1-2-3*, *VisiCalc*, *SuperCalc*, and *Multiplan* are available from **Cdex** (5050 El Camino Real, Los Altos, CA 94022; 415-964-7600). Δ The Managing Your Business Series is designed to analyze various aspects of business: sales forecasting, product margins, budgeting, cash flow, and so on. $69.95.

Δ *MetaBasic* is a precompiler for Basic that develops programs in a modular fashion. Programs written on *MetaBasic* can contain real subroutines (not gosubs) to other modules. Full argument passing is supported. From **M-R Associates** (162 Great Road, Acton, MA 01720; 617-263-0578). The package also compresses programs to allow for the use of descriptive remarks and clarifying spaces. For both interpretive and compiled Basic. $59.

Δ The new *Crosstalk XVI* communications package, now shipped with all pc Modem Plus systems, features script processing and terminal emulation. *Crosstalk XVI* ensures that less time is required to dictate a modem's operation. From **Ven-Tel** (2342 Walsh Avenue, Santa Clara, CA 95051; 408-727-5721). Modem Plus: $689.

Δ **Applied Software Technology** (170 Knowles Drive, Los Gatos, CA 95030; 408-370-2662) offers three new Versaform templates. *Mailing List* provides a database design for mailing labels. *Expense Journal/Distribution* and *Cash Receipts Journal* feature formats similar to a journal entry page. Both function as journal of original entry. $39.95 each.

Δ *Using 1-2-3*, by Geoffrey LeBlond and Douglas Cobb, is a book designed to provide an overview of the spreadsheet's features with detailed explanations and examples of keyboard macros, database functions, and graphics capability. Explanation of the special function

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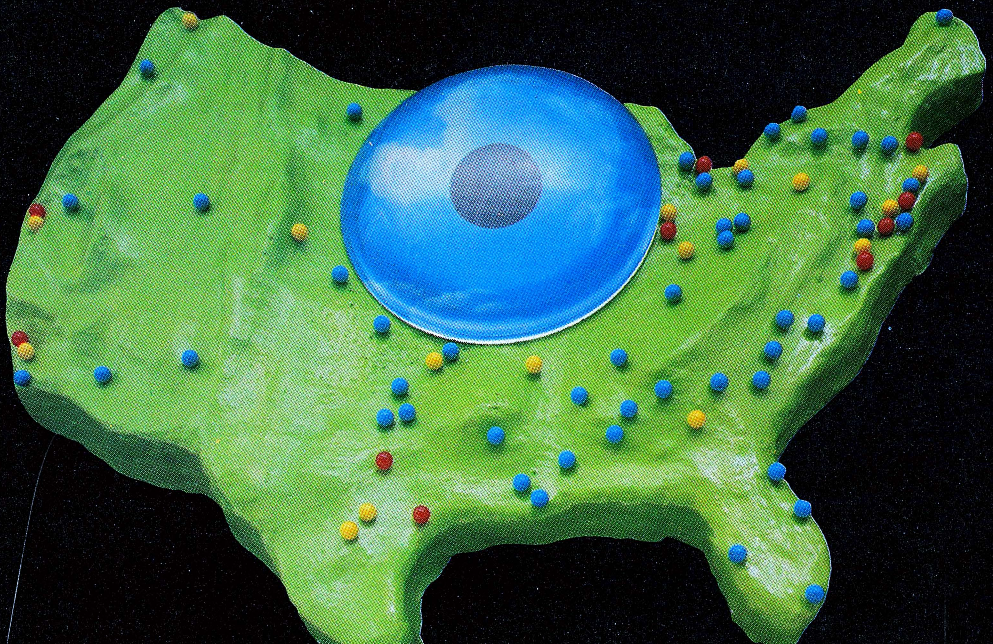

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keys is also included. Published by **Que** (7960 Castleway Drive, Indianapolis, IN 46250; 317-842-7162). $14.95.

Δ **Agricultural Software Consultants** (1706 Santa Fe, Kingsville, TX 78363; 512-595-1937) offers *Price-It,* a feed-pricing and inventory program for anyone who mixes and sells feeds. The program stores hundreds of ingredients and formulas, using either English or metric systems, and converts the company's *Mixit-2* ingredient lists to its own. $395. Demo: $30.

Δ Vertec's *Agency Automation System (VAAS)* provides independent insurance agencies with accounting, production control, commission reporting, and word processing capabilities. From **Vertec** (8079 North Lake Boulevard, Kings Beach, CA 95719; 916-546-8222), this PC-DOS version is identical in performance and capabilities to the CP/M release. $39.95.

Δ Designed for users of the popular database management system, *dBase II: A Reference Guide* is a forty-page, spiral-bound booklet that contains sections on commands, functions, data I/O formats, and control-key usage. From **GAA** (Box F, Deer Park, NY 11729; 516-586-8615). $9.95.

Δ *How to Use SuperCalc* is the newest audio-cassette lesson package from **FlipTrack Learning Systems** (999 Main, Glen Ellyn, IL 60137; 312-790-1117). Learn the commands and functions of the spreadsheet in the step-by-step development of a cash flow budgeting example. Four cassettes and lesson summary: $75.

Δ The Koala Touch Tablet allows you to draw patterns with a stylus or your finger on a four-inch-square digitizing tablet. From **Koala Technologies** (4962 El Camino Real, Los Altos, CA; 415-964-2992). Your drawings immediately appear on-screen and spaces can be painted in selected colors or a cross-hatch pattern. Modifiable as a joystick or a set of over forty function keys. Requires 128K, color/graphics adapter, games control board, and DOS 2.0. $100. Programmer's guide: $15.

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Δ An automated employee time and attendance system has been developed by **Coastal Data Products** (7370 N.W. Thirty-sixth Avenue, Miami, FL 33147; 305-696-6800). The software integrates the Smart Clock data collection terminal (a wall unit with internal microprocessor—similar to a time clock) and provides daily and weekly time and attendance reports, employee listings, and adjustment readings. Job costing and labor distribution options available. System: $675. Smart Clock: $2,695.

Δ Light gray characters on a blue background with boldface characters in white is one of the color combinations available with the *Color Qwerty* word processor from **HFK Software** (Old Danbury Road, Danbury, NH 03230; 617-259-0059). Free upgrade to *Qwerty* users. $325. One-month full-function trial copy: $25.

Δ Protective dustcovers made of canvas-weave cotton material with a soft inner lining are made by **Contemporary ComputerWear** (1320 Thirty-sixth Avenue, San Francisco, CA 94122; 415-564-0506). Design features include a woven binding and an embroidered red rose emblem. Covers are beige. Keyboard: $16. Drive, monitor, and printer: $18 each. One-piece monitor-on-drive combination: $36.

Δ **Reston Computer Group,** a division of Reston Publishing (11480 Sunset Hills Road, Reston, VA 22090; 703-437-8900), has announced a new line of business software called *Pro Works.* For use with *1-2-3,* the programs include *Executive Assistant,* a collection of time and work management tools. $100. Δ *Key Business Measures* is a program that converts financial data into displays. $100. Δ *Business Forecasting* provides an array of business statements and balance sheet forecasts. $100. Each package requires 256K, two disk drives, and *1-2-3.*

Δ The Qubie PC 212A/1200 modem card and *PC-Talk III* software are controlled with the same commands used with the Hayes SmartModem. From **Qubie Distributing** (4809 Calle Alto, Camarillo, CA 93010; 805-482-9829). The card features autodial in both pulse and tone as well as direct keyboard dialing. Software stores phone numbers, saves to files, and transmits from files. Cable included. $299.

Δ Manage your personal finances with *Certified Personal Accountant* from **Sundex Software** (3000 Pearl Street, Boulder, CO 80301; 303-440-3600). Handles cards, checking and savings accounts, and money market funds. Tax categories match those on an IRS form. Prints cash flow, net worth, and budget reports; also prints checks. $149.95. Trial offer: $19.95. Δ *Personal Payables* is a program for paying bills and organizing personal financial records. Handles up to ten separate checking and savings accounts, sixty different bills and recurring payees, and up to one thousand transaction entries per disk. $99.95.

Δ *Connexions,* from **Connexions** (55 Wheeler Street, Cambridge, MA 02138; 800-562-3282) is an interactive job database for technical professionals. Help-wanted ads are displayed by more than one hundred recruiters in corporations ranging from IBM, Wang, and GTE to Kay Instruments and Dynamic Research. Job seekers simply enter their resumes from their terminals if job descriptions correlate with their skills. Advertising is on-line for two months. $15 for two hours.

Δ Houston will play host to the IBM PC World Exposition February 2 through 5, 1984, at Houston Astro Hall. The show will be a regional dealer expo for the first two days, then the doors will open to the public. Seminars, conferences, and exhibits are planned for both audiences. Dealers can contact Mike Wayshak with **Mitch Hall Associates** (Box 860, Westwood, MA 02090; 617-329-7644).

Δ The G-Net Z-80 processor-based board allows up to two hundred fifty-five pcs to be connected in a local area network. From **Gateway Communications** (139 Alton Avenue, Santa Ana, CA 92707; 714-261-0762). The system allows databases and peripherals to be shared and is field-installable. Added features include a CP/M 2.2 software option and a 3270 terminal option as well as access to SNA, BSC, and X.25 networks. Software included: $595.

Δ A budgeting, forecasting, and discounted cash flow package called *Planfin* has been introduced by **Business Software** (10 Help Street, Chatsworth, N.S.W. 2067, Australia; 02-419-6077). The menu-driven

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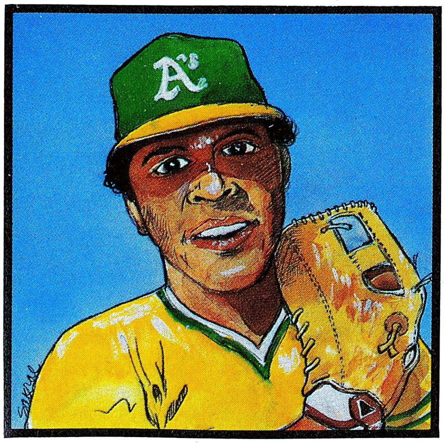
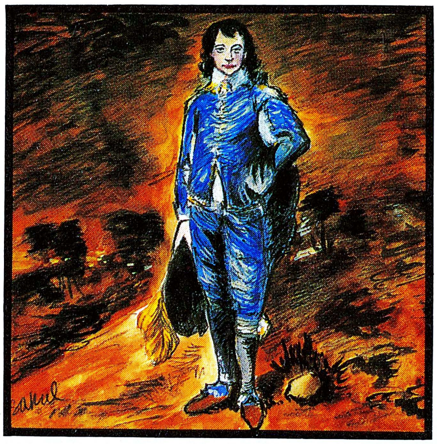
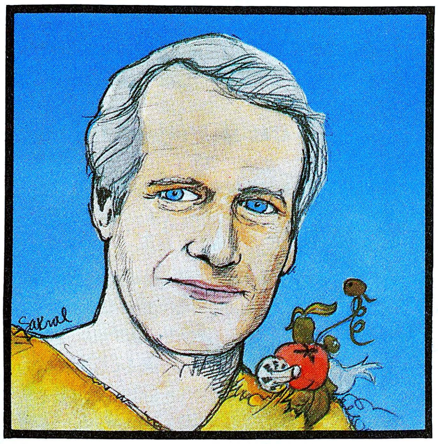


Famous baseball player.

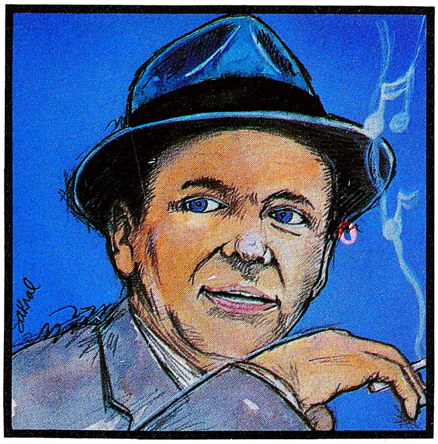


Famous 18th century painting.



Famous actor with those "Baby Blues" and a taste for salad dressing.

Famous "Big Blue."



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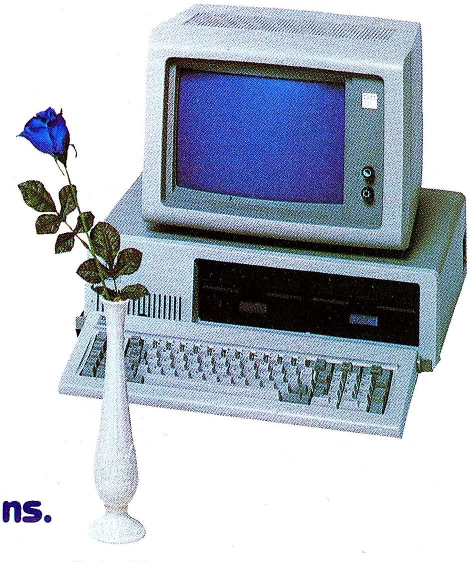

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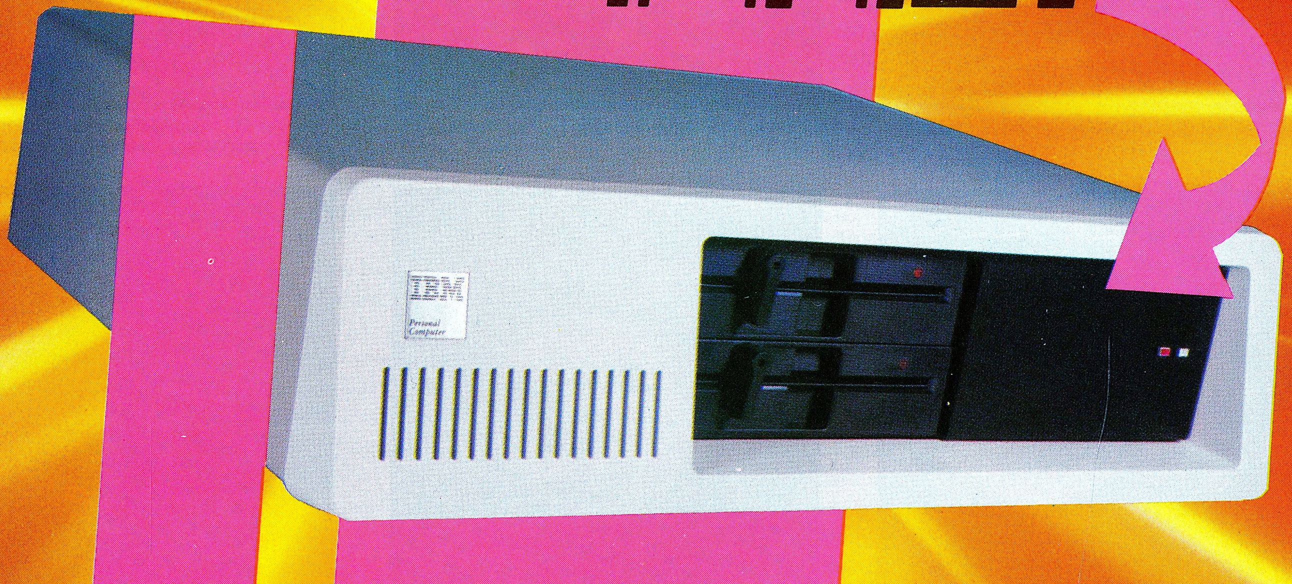

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Δ Back up and store files between a hard disk and one or more floppies with *Hard-to-Floppy Disk Dump* and *Restore*, two utilities from **Micro Systems Software** (2905-B Homestead Road, Santa Clara, CA 95051; 408-984-0660). Operation is similar to the copy command. Hard disk must be DOS-compatible. $50.

Δ *p-Comm 3.0* is an upgrade of the professional communications package for p-System users. Features single-keystroke directory control, the widely used Christensen protocol, and pacing protocol for older computers that prompt for each line of text. From **ErgoSoft** (7122 Cather Court, San Diego, CA 92122). $95.

Δ *WordStar in Everyday English* is a book written for the person who knows absolutely nothing about a computer. From **Devin-Adair Publishers** (143 Sound Beach Avenue, Old Greenwich, CT 06870; 203-637-4531), the one-hundred-sixty-page publication is organized by the job that needs doing, not by computer function. $9.95.

Δ An electronic shopping catalog is available from **IBM** (Box 3148, Wallingford, CT 06494; 800-426-2468) and offers a wide range of pc-related products. Hardware, software, disk accessories, printer accessories, books, and computer furniture can be ordered from the disk catalog by calling the company direct. $3; refundable with first purchase.

Δ The Inline Data Entry Station provides a slanted document surface positioned just above the keyboard that puts material to be entered right in front of you. From **Pentek Products** (Box 54, Wellsboro, PA 16901; 717-724-2554), the station has space for the system unit and a monitor to be stacked above the slanted work surface. Built of furniture-quality laminate; smoke-gray color. $179.

Δ **Bristol Information Systems** (84 Main Street, Fall River, MA 02720; 617-679-1051) has announced a new line of business software. Packages include general ledger, payroll, accounts payable and receivable, inventory, order entry/billing, and professional time accounting. All modules are menu-driven, have unlimited file size, and are fully integrated. Construction accounting and estimating, wholesale distribution, and newspaper circulation modules available. $800 per module. Three for $2,000.

Δ Two publications from **Microcomputer Applications** (827 Missouri Street, Fairfield, CA 94533; 707-422-1622): *High-Tech Consulting: A Guide to Making Money as a Computer Consultant*, by John Zarella, provides essential information for anyone considering computer consulting as a career. Paper: $18.95. Δ *Consultant's Log* is a monthly record-keeping logbook to record mileage, time spent on each project, and more. Paper: $3.

Δ *Labyrinth Run* is a game designed for the monochrome monitor. The object is to capture all the computer's markers by running them into walls before it captures your marker. False walls, invisible walls, and a teleport option add to the fun. From Dennis Charles Smart & Company (6848 B Seagull Lane, New Orleans, LA 70126; 504-245-8439). $25.

Δ **VisiCorp** (2895 Zanker Road, San Jose, CA 95134; 408-946-9000) has announced *VisiCalc IV*. The new program integrates all the features of the standard *VisiCalc* with graphics, sorting, spreadsheet management, and easy function-key definition. "What if" calculations can now be seen graphically in any of eight graph options. Sorting can be performed on rows or subsets of rows enabling quick projection reports. Sixty-six commands can be stored. $250.

Δ A multiuser version of the *MIS Builder* database management system is now available for *PCnet* from **American Planning** (4600 Duke Street, Alexandria, VA 22304; 312-751-2574). The system integrates a menu-driven database manager with an automated program development system. Handles up to eighty thousand records. $495. Functions package for advanced programmers: $295.

Δ Two training programs on disk are available from **Witech** (763 Vallejo Way, Sacramento, CA 95818; 916-441-7772): *Witech Tutorial for DataStar* covers the database software in depth, from form design to file maintenance. Two disks. $59.95. Δ *Witech Tutorial for ReportStar* starts with an introduction to the report generator and includes advanced report design. Two disks. $59.95.

Δ Emulating the pc disk-controller instruction set, the P-Series Disk Controller card is DOS 2.0-compatible and takes full advantage of the existing software base. From **Adaptive Data & Energy Systems** (2627 Pomona Boulevard, Pomona, CA 91768; 800-824-0114). Additional features include multiple sector read/write and physical sector operations. $395.

Δ For the business manager: The *Open Access* package includes an electronic spreadsheet, a 3-D color graphics, word processor, appointment scheduler, and communications. From **Software Products International** (10343 Roselle Street, San Diego, CA 92121; 619-450-1526). Windows enable simultaneous viewing of operations; option to use a mouse is built in. $595.

Δ *The Computer Publishing & Advertising Report* provides readers with facts and figures about the computer publishing and advertising

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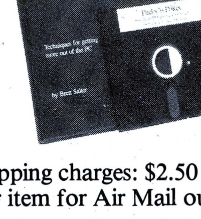

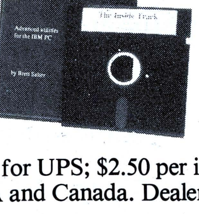

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field. Published biweekly by **Communications Trends** (710 Webster Avenue, New Rochelle, NY 10801; 914-576-7175), the publication tracks market trends, new opportunities, lurking dangers, competitors' plans, and more. Six months: $98. One year: $188.

∆ A surge suppressor unit that can handle six devices with a combined load not exceeding 1,875 watts, the Electra-Guard System 6 provides line-to-line and line-to-ground clamping protection with a response time of less than five nanoseconds to overvoltage spikes and surges. From **Computer Power Solutions** (8800 Forty-ninth Street North, Suite 203, Pinellas Park, FL 33565; 813-544-8801). $69.95.

∆ **The Computer/Investor User Group** (36 Highland Avenue, Metuchen, NJ 08840; 201-494-1200) shares information on databases and programs covering all aspects of using computers to aid in investment decisions. Membership includes a ten-issue newsletter, consultation, seminars, a group discount card, telephone assistance, and optional database services. $145 per year.

∆ *The Law Office Guide in Computers,* from **L.O.G.I.C.** (Box 701-B, Larkspur, CA 94939; 800-227-3800), is a monthly newsletter for lawyers and legal administrators that features articles and reviews. Topics covered include word processing, consultants, hardware and software, plus purchasing guidelines and conference and trade show news. $120 per year. ∆ *The L.O.G.I.C. 1984 Directory* is a resource book of product and service listings. $110.

∆ Project managers can use the *Project Cost/Management Information System* for project planning, scheduling, budgeting, and performance monitoring. The PC/MIS software assists in testing and evaluating cost implications of alternative project labor mix and tracking contracts. Also has built-in audit routines. From **Davis & Associates** (1655 Peachtree Road N.E., Atlanta, GA 30309; 404-875-0793). $495. Demo: $50.

∆ Learn how to sell your own personal software creations in an eighty-page manual from **Associated Technology** (Route 2, Box 448, Estill Springs, TN 37330; 615-967-9159). Topics covered show users how to obtain national directory listings, price new products, operate a successful mail-order fulfillment service, and write a user's manual. $20.

∆ A *VersaText Word Processor and Database System* in Hebrew is available from **TexaSoft** (1028 North Madison Avenue, Dallas, TX 75208; 214-946-7912). The system can perform a variety of office jobs, such as mail merge, label generation, reports, and letters. Entries can be made in both Hebrew and English characters by way of a character-generator chip available for support on the monochrome or graphics adapter. $400 to $500.

∆ Compare leading word processors, feature by feature, using the *Word Processor Comparison Tables.* Comparisons of more than one hundred fifty features of forty leading packages are included, along with guidelines for selection and a checklist for contract negotiations. From **Information Research** (10367 Paw Paw Lake Drive, Mattawan, MI 49071; 616-668-2049). $39.95.

∆ Used by the Army and currently being evaluated by the Navy, *QTime* is a fully automatic, menu-driven database management system that includes a tutorial mode for easy learning. Modification and updating of applications can be done without programming or procedural language experience. From **Quality Information Systems** (2801 Buford Highway N.E., Atlanta, GA 30329; 404-325-0987). Executive version: $695. More advanced professional version: $995.

∆ *GrafTalk* is a business graphics package from **Redding Group** (609 Main Street, Ridgefield, CT 06877; 203-431-4661). English-language commands allow the software to produce stacked, percentage, clustered, or floating bars; exploded pies; scatter diagrams; line and combination plots; and a range of *move, draw,* and other graphics and text commands. Supports a range of popular plotters. $450. ▲

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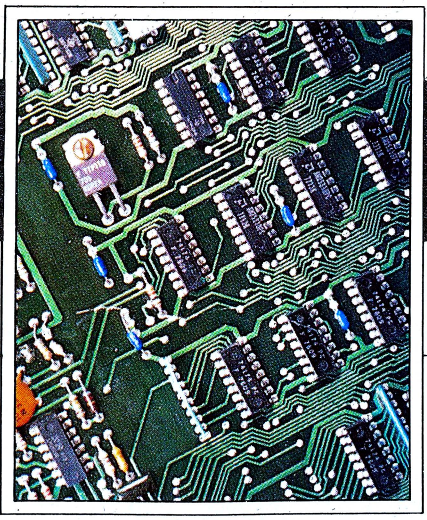

BOARDS AND BUSES

by Kevin Goldstein

Great Lakes Revisited

Priced at a thousand bucks, the ten-megabyte hard disk subsystem from Great Lakes was the deal of the year. Unfortunately, as noted in this column last month, that outstanding price was offered for a limited time only. Get your order in now, folks; you'll never see another offer like this. The disk reads, it writes, it dices, it peels . . . but you get the message.

The offer expired October 15, Great Lakes has become Pegasus, and the same disk can be had through your friendly local dealer, only now it will cost you $1,395. For the extra $395 you get the chance to try out the disk in the showroom to see if it works with your own software before you buy, as well as dealer support—nontrivial add-ons, considering the (usually well-hidden) complexity of hard disk systems.

Even at $1,395, the drive is still a pretty good bargain. A study of the latest advertising shows a number of manufacturers offering IBM pc compatible drives. None of the ten-megabyte-capacity drives is priced lower than the Pegasus offering; as a matter of fact, few other manufacturers or distributors come close. There are a few five-megabyte drives in the same range, but a five-megabyte drive can't be completely compatible with the XT.

As it turns out, the Pegasus drive isn't totally XT-compatible either. As of now, there appear to be only two companies offering true XT-compatibility: Mountain Computer and Apparat. If you intend to use your pc with only PC-DOS, the incompatibilities range from minor to nonexistent. But if you plan to use some other operating systems, you could run into trouble—as noted later in this column.

The drive we received to replace the original but faulty drive has been relatively trouble-free. In particular, the intermittent high-pitched squeal caused by the static discharge brush riding against the bottom of the flywheel—a harmless but teeth-gnashing annoyance—has been tamed. According to Great Lakes president Dick Brown, the manufacturer (Shugart) tweaked its manufacturing process and the problem has been banished for good. Nor did this disk need to be jump-started, although since the cause of that rather strange malady is unknown, it could turn up again in the odd unit here and there. Great Lakes has gone to a better shock absorber for its packing material, so if that was the cause of the problem, it too may be gone for good.

There's good news and bad news about using the Great Lakes disk, although by far most of the news is good. Probably the most welcome thing about this unit is how absolutely quiet it is. Compared to the Great Lakes disk, the XT's sounds like a jet engine. Great Lakes spent a little extra money on a high-quality whisper fan, and it was money well spent.

The hard disk is interfaced to DOS 2.0 via an installable device driver supplied by Tallgrass Technologies. (Great Lakes is a systems integrator, remember, not a manufacturer.)

The Tallgrass driver permits some flexible configurations of the hard disk that are simply not possible with the XT using IBM standard software. To wit: It is possible to partition the disk so that it appears to be a number of separate drives of arbitrary size. For example, a single drive can be configured to be drive C with five megabytes, drive D with three megabytes, and drive E with two megabytes. A single drive can be partitioned into as many as thirty-two partitions (although only sixteen may actually be active at any one time); each "logical" drive (that is, partition) can be any arbitrary size, as long as the total size of all partitions is no larger than the total capacity of the disk, of course.

As good as the Tallgrass driver is in operation, that's also how bad it is during installation. To put it bluntly, the Tallgrass user interface is a mess. The only way to get through the whole thing with sanity intact and disk properly configured is by following the directions in the manual keystroke by keystroke. Just pretend you're baking a fancy souffle and following the directions to the T.

Not that the directions Great Lakes supplied are so great. As a matter of fact, they do little to make the job easier. Nonetheless, after two or three tries you'll probably get the job accomplished. One note here might help: Near the end, there's an instruction that says, "Set the active drives to ⟨2⟩⟨ENTER⟩ (Set the logical number as required.)" What this really means is set the *logical* number of drives to the number of partitions you have created (which in the example is 2). Period. If, for example, you created drives C, D, and E, on the hard disk, you would type a 3 at this point.

Great Lakes has promised a revamping of the installation manual. The manual that came with the replacement disk was different from the original, but not a whole lot better. Here's hoping the next vamping takes care of the problem.

In operation, a pc running Great Lakes' ten-megabyte disk operates a lot like, although not identically to, an XT. The main difference is at boot-up time: You can't boot from the add-on hard disk. At boot time, both the XT and the pc fetch instructions from the onboard ROM. In the XT, these instructions tell the microprocessor to look first at the A drive floppy disk for a copy of the operating system; if no floppy disk is found, the instructions direct the microprocessor to look for a boot record on the hard disk.

The pc contains a different ROM, which knows nothing of hard disks, so the pc must always boot from the A drive. That's where the Config.sys file comes in; DOS knows to look for such a file on the boot disk, and if such a file is found, any device drivers specified therein are loaded. Since the device driver is loaded before the Autoexec.bat file is read, it can automatically log the now-installed hard disk drive as the default drive. If you always keep a boot disk in the A drive, the pc and XT will look the same at start-up.

They should look the same after that, and the fact that they don't is no fault of Great Lakes'; it's because DOS 2.0 has a bug in it. Unlike DOS 1.1, DOS 2.0 (supposedly) imple-

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ments a method by which the user can substitute a shell of his choice for the standard version of Command.com supplied with DOS. The trick is supposed to be possible either by specifying *Shell*=⟨*name of substitute shell*⟩ in the configuration file, or by altering the *Comspec*=⟨*name of active shell*⟩ in the environment. Assuming that either one worked (which neither does) and that C was your hard disk drive, you could simply specify

COMSPEC=C:COMMAND.COM

in your Autoexec.bat file, and then whenever DOS needed to reload the transient portion of Command.com, it would know to look on the C drive for it. (To save space, DOS allows application programs to overlay a certain portion of the operating system. The overlayable portion, called the transient portion, must be read back into memory when the application program returns control to DOS.)

Since you can't do that because the command doesn't work properly, DOS will go to the boot drive to reload Command.com. This means that whenever a large program concludes, you must return the boot disk (or any other disk that has Command.com on it) to the A drive. It also means you've got to put up with irritatingly slow floppies, which is not something you want to do after spending mucho bucks for a hard disk. Let's hope the problem will be fixed in DOS 2.1. In the meantime, we're working on a temporary patch.

There are two other places in which you'll notice the difference between an XT and a pc with a Great Lakes disk. The first is when you try to partition the hard disk to support the UCSD p-System; as of now it's not supported, and there are no plans to do so. (CP/M support, on the other hand, has been promised for the near future.) For that matter, you're liable to run into problems when trying to use any "foreign" operating system; Venix, for example, has recently become available for the XT, but as of now it can't be run from a "nonstandard" hard disk. (We're working on this one, too, although it doesn't look good at the instant. More in a future issue.)

The moral here is that if you plan on using any "nonstandard" operating system (meaning anything other than PC-DOS) and you want to be able to run that system from the hard disk, you'd do well to think long and hard about using hard disks whose interfaces do not conform exactly to the XT's. (We'll be looking at the drives from the two manufacturers who do claim a 100 percent XT-compatible interface. More on that, too, in a later installment.) In the case of Venix, the option of running off floppies doesn't even exist; Venix requires a hard disk. Right now, that means if you want Venix, you need an XT.

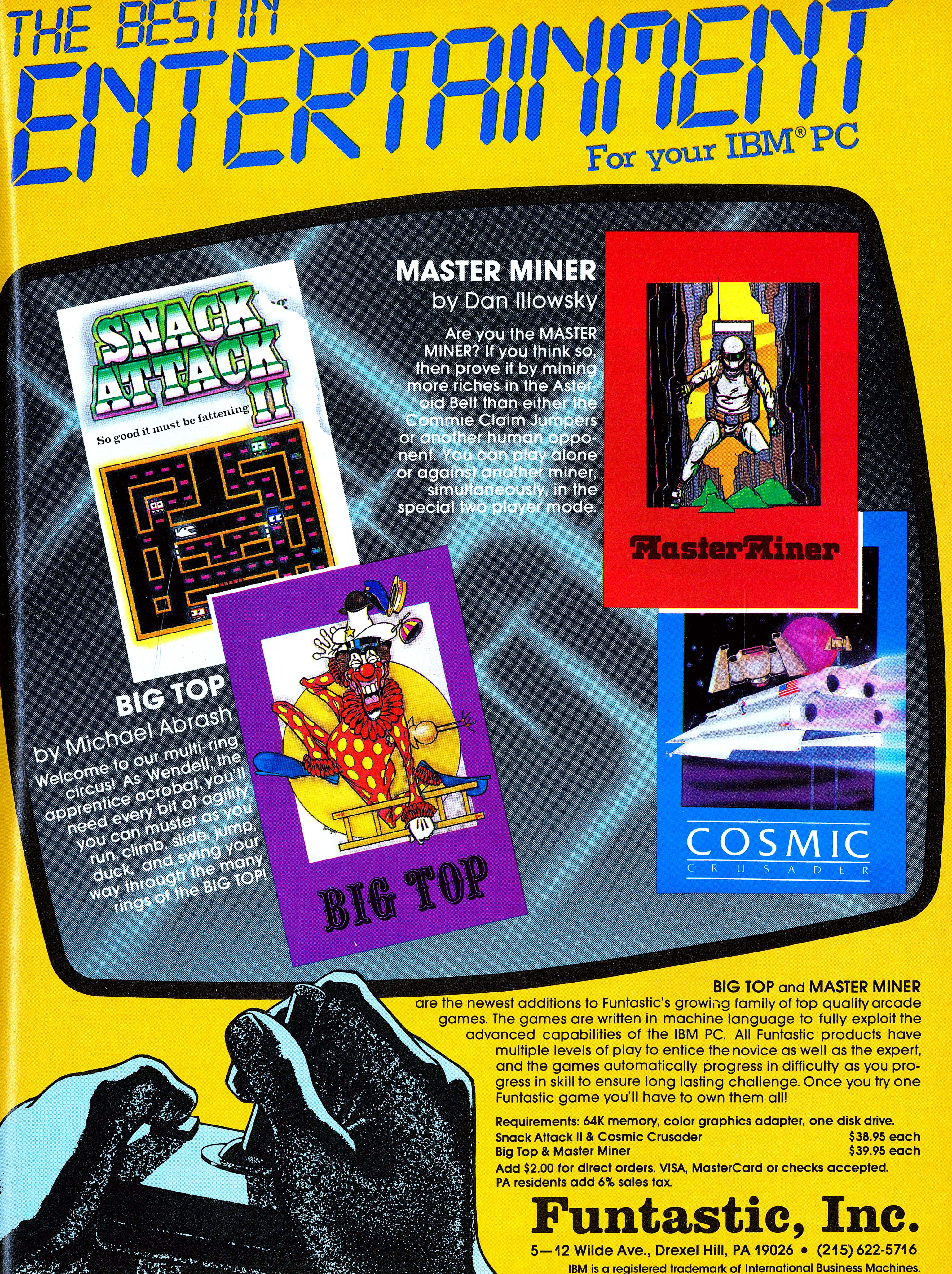
If this column seems to be ignoring the often-raised subject of speed, that's because it is. Speed benchmarks (comparisons), unless done in a lab under the most careful of conditions, are often more misleading than helpful. (As some pundit once said of benchmarks, "There are lies, there are damned lies, and there are benchmarks.") Further, unless your applications are incredibly I/O-intensive, you're simply not going to notice the difference between a disk with sixty-five-milliseconds average access time and one with ninety milliseconds. (The data transfer rate for disks of this size has been pretty much standardized at five megabits per second.)

If you do find yourself in the position of having an important I/O-bound application, the most accurate test would be to run your own program at a dealer's showroom, since the relative speeds of two disks can vary when run with different application programs. For what it's worth, seat-of-the-pants measurement says that the Great Lakes disk offers about the same speed as the XT's.

That about takes care of the really important points, although a couple of nits that came up during installation are worth mentioning. Any hard disk requires a host adapter card—a card that plugs into the bus of the pc and connects to the hard disk via a flat cable. The host adapter boards supplied with both the original Great Lakes disk and the replacement were lacking a back panel cover and connector; that made it necessary to thread the cable end through the back panel, attach it to the host board, and then install the host board. That makes for a somewhat sloppy installation, and Great Lakes has promised to supply a back cover with connector. Also, the cable itself could be a foot or two longer. (If you get a long enough cable, you can get the whole box off the desktop, a not unimportant consideration in view of the potential proliferation of peripherals an active pc'er faces.)

Incidentally, Great Lakes includes software with its disk that allows you to run it under DOS 1.1. With DOS 2.0 going for only $60, there seems little reason not to move up and take advantage of that much more powerful operating system. Even so, if you want to use the disk with 1.1, you can.

Now That's Portable. One of the real movers and shakers in the world of computers is Alan Kay, designer of Xerox's Alto computer, from which we got both the mouse and the concept of overlapping windows. One of Kay's Holy Grails, and an idea that has been seminal in the evolution of personal computers, is what he calls the Dynabook, a portable personal computer that "could be owned by everyone and could have the power to handle virtually all of its owner's information needs." Dynabook would be notebook-sized, which is in keeping with Kay's own rather succinct working definition of a portable: a computer that can be carried in addition to something else. ▲



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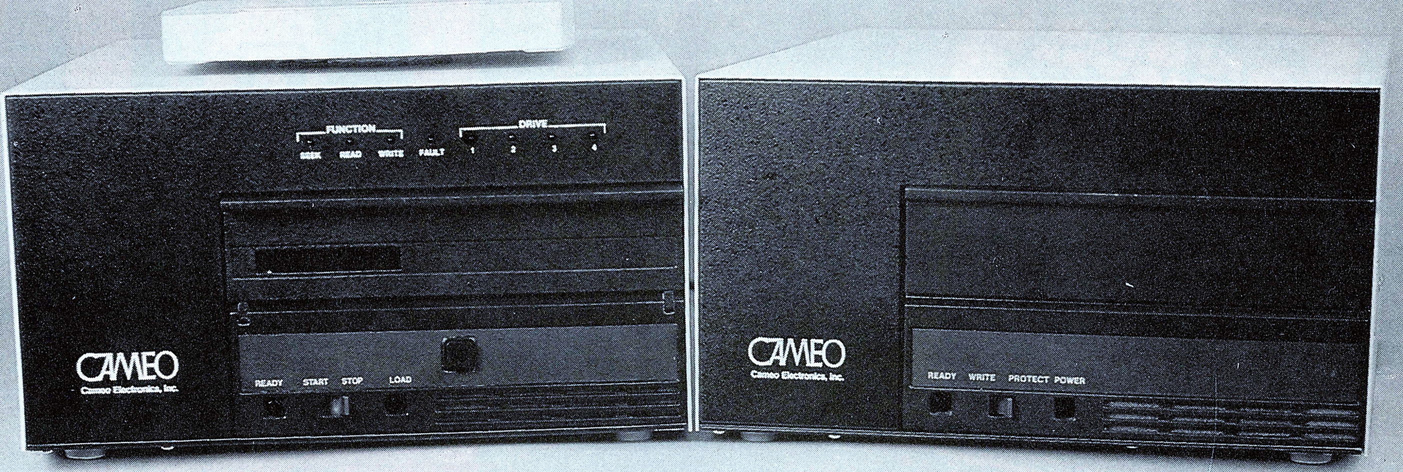

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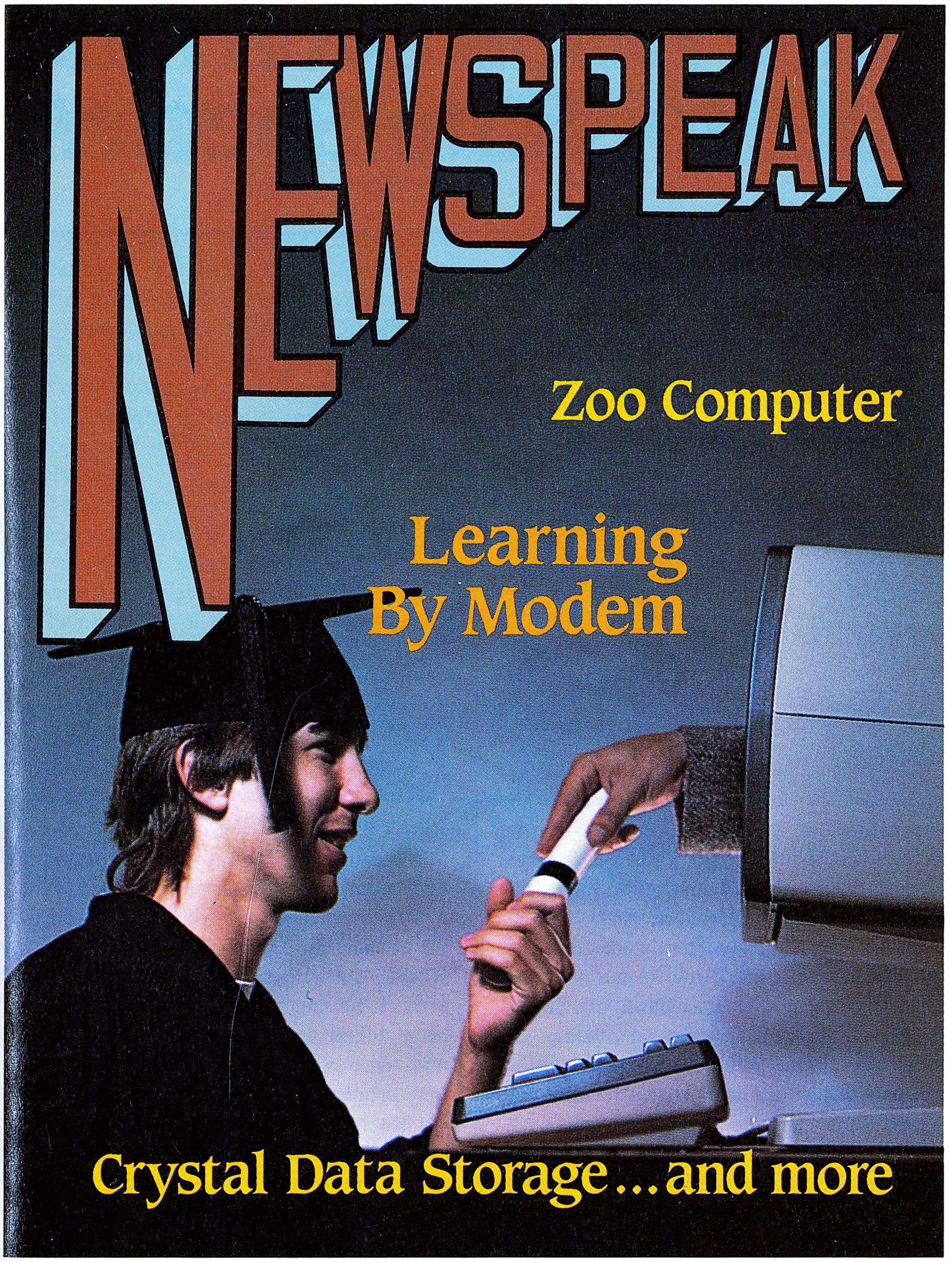


EDUCATIONAL NETWORK USES MODEMS AND MICROCOMPUTERS

On September 12, TeleLearning Systems of San Francisco, California, announced a development that should go a long way toward making the "computers in education" revolution come to pass—the TeleLearning telecommunications system, a package designed to transform a personal computer into a personalized "electronic university."

So far, versions of the TeleLearning telecommunications system package are available for use with any Apple II series machine and the IBM Personal Computer. A Commodore 64 version will be released this month, to be followed shortly by versions for TRS-80 and Atari machines. All versions require disk drive and monitor; a printer can also be used, though none is required.

The basic TeleLearning package is composed of a 300-baud autodial modem (the "knowledge module"), communications and educational environment software, and a catalog that lists the courses offered, what they cover, and what they cost. For the benefit of computerists who already own modems, the TeleLearning software can also be purchased separately. And for computer novices, there's a special package containing the knowledge module, TeleLearning system software, course catalog, and instructional

GOTO page 196, column 2

AT&T MICRO TO COMPETE WITH IBM'S

Better late than never. American Telephone & Telegraph is planning to enter the microcomputer market within the next six months.

According to a recent report published by International Resource Development (Norwalk, CT), AT&T's micro will use thirty-two-bit architecture based on Western Electric's Bellmac microprocessor and will feature software based on Bell Laboratories's Unix operating system.

It's long been expected that AT&T would clash head-on with IBM and other office automation companies, once the communications giant had freed itself from public utility status. AT&T is looking to invade IBM's territory but realizes how strong Big Blue's position is. The bout has just begun.

AT&T's micro will have the option of running software developed for the IBM pc, according to the IRD report—which is titled *Microcomputer Operating System Strategies*. Microsoft, apparently, is developing a "MS-DOS look-alike" program for the new computer.

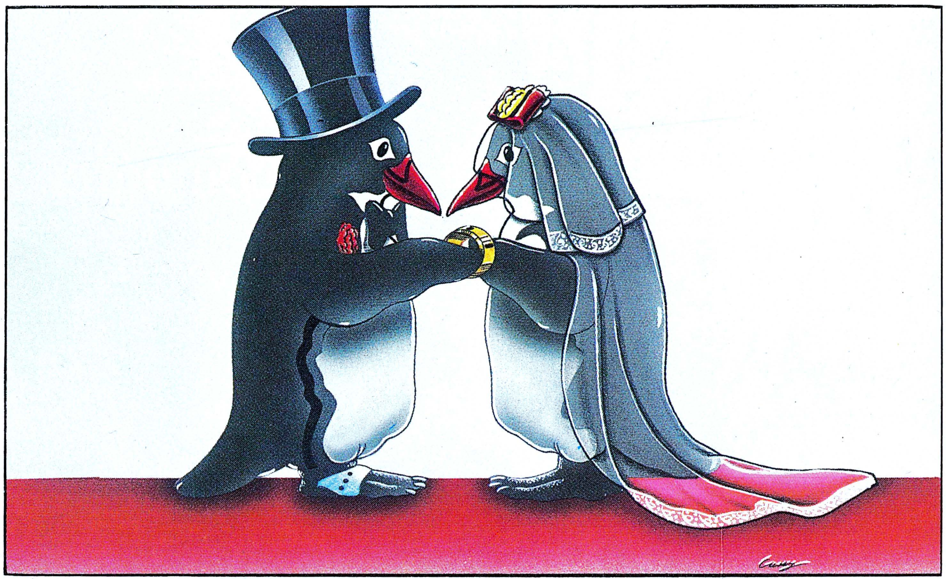
IBM, on the other hand, may implement "selective price reductions" to undercut AT&T and is encouraging the development of Unix-based operating systems for several IBM computers, including the pc. IBM is also now geared up to outproduce AT&T, at least through 1984.

The AT&T micro is not expected to feature Lisa-like software. IRD does not rule out, though, a crash effort or "maybe another deal with Microsoft"—whereby AT&T's micro would be equipped with Lisa-like productivity tools or something like VisiCorp's long-awaited *VisiOn*, which will run on the IBM pc.

Throughout the IRD report, the importance of operating systems is emphasized in relation to competitive strategies for success in the personal computer market. The report predicts that MS-DOS will be running on 50 percent of the microcomputers in use in 1986, compared with 29 percent in 1983. Unix, running on only 2 percent of the computer population today, will run on 10 percent in 1986. But by then, MS-DOS will be nearly equivalent to Unix—with Smalltalk-like (Smalltalk was the inspiration for Lisa's operating system) enhancements and other extensions—according to IRD researchers.

GOTO page 194, column 3

Computer Service Helps Zoos Find The Perfect Mate for Rare Species



Nathan Flesness likes to tell a story about a zoo that was famous for its penguins. This zoo had the largest and most diverse penguin population in the country. And all other zoos came to this zoo to buy or borrow offspring of the famous penguins to add to their own penguin populations.

Eventually, all the penguins in the zoo's exhibit died. Immediately, an investigation was launched. A great deal of money was spent, all possible factors were weighed, and, in the end, the cause of the devastation of the zoo's famous penguin population was discovered: old age. The zoo had been using only its original penguins for breeding, while selling off the offspring. And no one had thought to keep track.

Flesness is the director of ISIS, the International Species Inventory System, which is dedicated to making sure that things like that don't happen again.

The capture and importation of animals belonging to endangered species became forbidden in the early seventies. That constraint, plus other import restrictions and quarantines, meant that zoos had to obtain virtually all their animals from captive populations—which are never the demographic equal of what they would be in the wild and, in the case of endangered species, could be smaller than your immediate family.

Ten years ago, at the Minnesota Zoo, Drs. Ulysses S. Seal and Dale Mackey thought it would be helpful to have a source of information on wild animals in captivity comparable to the files kept on people by government agencies and financial institutions. The animal files would be geared to the survival of species rather than the catching of tax cheats and parking violators. And zoos could know what other zoos had.

Seal and Mackey took their idea to the American Association of Zoological Parks and Aquariums and the American Association of Zoo Veterinarians, both of which agreed to participate and help out with funding. More money from a private foundation and a grant from the Department of the Interior followed.

The result was ISIS, a comprehensive collection of information on fifty-seven thousand captive birds and mammals in 175 locations around the world, stored and maintained on mainframe computers. The main database consists of such basic information as an animal's age, sex, parentage, where it was caught or born, its current location, and where it is scheduled to go. Linked databases have more specific information and medical histories for disease detection.

Participating zoos (currently consisting of the majority of North American zoos, thirteen European, two New Zealand, one South American, and growing by an average of fifteen new members annually) now can locate genetically desirable mates for specific animals and develop intelligent breeding practices.

Suppose a zoo wishes to find a suitable male Przewalski's horse for its female Przewalski's horse and indicates that it wishes to participate in the ISIS program. ISIS sends a set of standard forms. The zoo director fills them out with the requested info on all the zoo's animals, keeps a carbon, and returns the forms to Minnesota. There, one of the four full-time ISIS employees batches all the forms and enters them into the computer.

The zoo director is now entitled to a 500-page document with the basic information contributed by the 175 participating zoos and institutions. Every six months, he also gets a microfiche record on all 57,000 animals. If there's an eligible male Przewalski's horse in there, he will probably find it.

This process is not exactly the epitome of the streamlined, high-speed computer age.

"We've got 150 megabytes of data sitting in a drawer," sighs Flesness. The lack of sufficient funds to maintain a hard disk and the inability of zoos to take advantage of an online database, even if the system could afford it, has caused ISIS to embark on a quest for a microcomputer programmer who can create a program that will expedite the record keeping at individual zoos.

ISIS is now looking for a sponsor for the project, having already sunk $300,000 into three failed tries—attempted by programmers who believed it was a standard inventory problem.

"It's not," says Flesness. "The program has to update, edit, and have several report-writing functions. It'll need to communicate with the ISIS system and deal with the fact that an animal does not have a constant I.D. Each zoo has its own identification system."

Last June, Washington's National Zoo became the first to computerize its animal records. It sent a magnetic tape off to ISIS instead of a printed report. This was a start. The dream of a microcomputer-based, ISIS-compatible, two-way telecommunication system has yet to be realized, but the organization expects it to happen "within a couple of years."

The continuing expansion of ISIS (they're now working up a database for reptiles and amphibians) is not analogous to a successful business interested in improving its operations. For many animal species, the captive populations may soon be the only ones left on the planet. The existence of these captive populations will depend increasingly on cooperative management between zoos based on good, readily accessible biological information. AC

NARA Sponsors High-Tech Forum Featuring Digital Music System

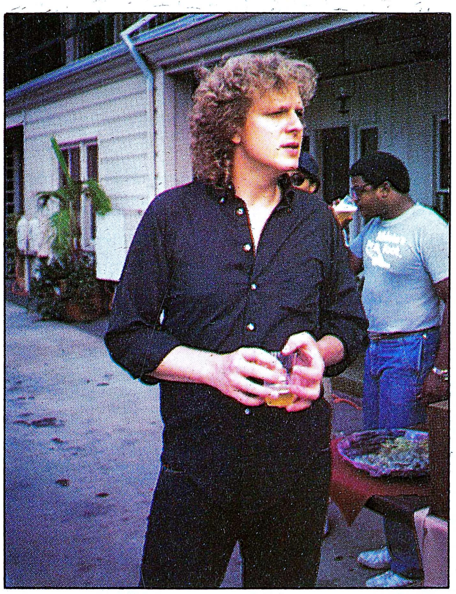
The National Academy of Recording Arts and Sciences (NARAS)—the august assembly that presents the Grammy Awards each year—sponsored the second annual digital synthesis forum this past September to promote the advancement of knowledge about digitally generated music among NARAS members and other music industry professionals.

The affair drew around five hundred attendees and featured hands-on interaction with practically every digital-based music system currently available.

The organizer of the forum was Michael Boddicker, the current governor of the NARAS board of trustees, as well as a composer and keyboardist who has contributed his talents to many albums of note. Herb Alpert and Don Hahn donated the use of the multi-studio facility of A&M Records, located on the site of the former Charlie Chaplin studios in Hollywood.

The size of the facility enabled the manufacturers that were showcasing their products to do so in separate, well-insulated rooms that had been acoustically fine-tuned. This permitted each product to be viewed and heard discretely, without distraction. According to Boddicker, the likes of Barbra Streisand, the Police, and Sergio Mendes, who were slated to use the studio for current productions, generously rearranged their recording schedules to accommodate the event.

Among the manufacturers that provided top-of-the-line computer-based instruments for the attendees to scrutinize were digital-music heavyweights Fairlight and E-mu Systems. Music Technology Incorporated presented its Synergy digital keyboard instrument. Music Technology's vice president, Tom Piggott, proposed mounting a showcase concert—early next year at Carnegie Hall—featuring Boddicker on the Synergy.



Michael Boddicker, NARAS forum organizer.

Other instruments presented were Yamaha's new DX-7 digital synthesizer, the OB-8 composer/sequencer/rhythm generator from Oberheim, and the Casio 7000 polyphonic synthesizer. Standalone digital rhythm generators (drum machines) included the Linn Drum, Simmons electronic drums with the peripheral SDS6 sequencer, and E-mu Systems's Drumulator. Garfield Electronics showed the Doctor Click, a device that allows the user to interface synthesizers, sequencers, and rhythm generators—from different manufacturers—that otherwise would be incompatible.

The issue of system compatibility was addressed further by those manufacturers who have committed themselves to producing equipment fitted with the Musical Instrument Digital Interface specification, or MIDI. This hardware-based system, and the nonproprietary language it uses, makes it possible to interface instruments from different manufacturers under the control of an external microcomputer. Roland Corporation featured MIDI on its Jupiter-8. Moog harnessed MIDI to its newly released SL-8 synthesizer. Sequential Circuit's Prophet 5 synthesizer was interfaced with the Commodore-64.

The recently formed MIDI Users Group was represented at the forum by organizer Brian Vincik. This organization's goals entail the dissemination of technical information about the MIDI specification, the development of an interactive database for users, the presentation of seminars bringing users together, and the publication of a newsletter.

Apple-based systems included the Soundchaser from Passport Designs, the alpha-Syntauri from Syntauri Corporation (with the new *Simply Music* software), and the Chroma from Fender/Rogers/Rhodes. Programmer Kevin Laubach was on hand to demonstrate the new software he had developed for the Chroma, which provides an on-screen graphic representation of the synthesizer's patches as you modify them.

Other notable systems are the PPG Wave 2.2 polyphonic synthesizer and the optional Waveterm, which includes a monitor and eight-inch drives and which allows the sampling and treatment of acoustical sounds. Also, 360 Systems demonstrated a digital keyboard that plays recorded acoustic sounds—from instruments and percussion to human vocalizations—which are stored in memory chips that can then be purchased individually.

Boddicker, who currently is composing the music for the new *Star Trek* game to be published by Sega, echoed the participants' feelings that the event was a success. The first digital synthesis forum was held at United Western Studios in Los Angeles a little more than a year ago, with fewer musical products presented and about a hundred attendees. It is Boddicker's hope to maintain the intimate, hands-on atmosphere that characterized this year's forum in subsequent gatherings. TG

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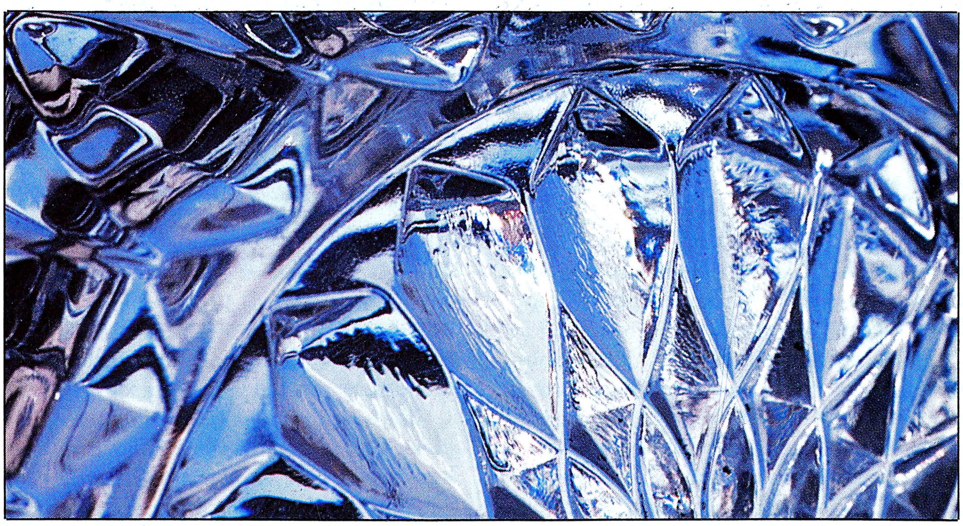
Scientists Look at Crystals As a Data Storage Medium



First it was stone. Then it was animal hides, papyrus, felted vegetable fiber, celluloid, magnetic tape, and silicon chips. One of the longest ongoing quests of humankind is the search for a better way to store information.

The combination of lasers and photorefractive manmade crystals is one of the most exciting future data storage technologies currently being explored in research labs around the world. The theoretical potential for storing data on crystals is tremendous.

"The problem is making large, high-optical-quality, homogeneous crystals and controlling, in a predetermined fashion, their properties, microsensitivity, and storage density," says Lynn A. Boatner, a physicist at the Oak Ridge National Laboratory in Tennessee.

Boatner is involved with the "materials science" aspects of developing methods and techniques for creating an active medium out of photorefractive crystals. Originally begun at the Phillips Research Lab in Hamburg, Germany, Boatner's research in crystals is something he works at on the side at Oak Ridge. The lab is funded by the Department of Energy and there are no direct energy applications currently foreseeable from crystals.

Nevertheless, Boatner is excited by the potential of manmade potassium tantalate niobate crystals, niobium oxide, and potassium carbonate. The ratio of niobium to tantalum can be changed and other substances added to alter the crystal's properties.

Laser light of a proper wavelength alters the crystal's index of refraction at illuminated points within the crystal. The spots of altered refractive index shift a light beam's path slightly. A laser beam of another color can read information, encoded by the original laser, without changing it.

How much information can a crystal store? "All of man's knowledge would probably fit on a cubic crystal one meter on each side. We can't grow one that big, though." Still, Boatner says it's not hard to imagine the day when you'll have the contents of the Library of Congress on a crystal in the home.

Boatner also believes you could store holographic images as interference patterns on a crystal. By rotating the crystal slightly between each illumination, one could pack it with thousands of such images.

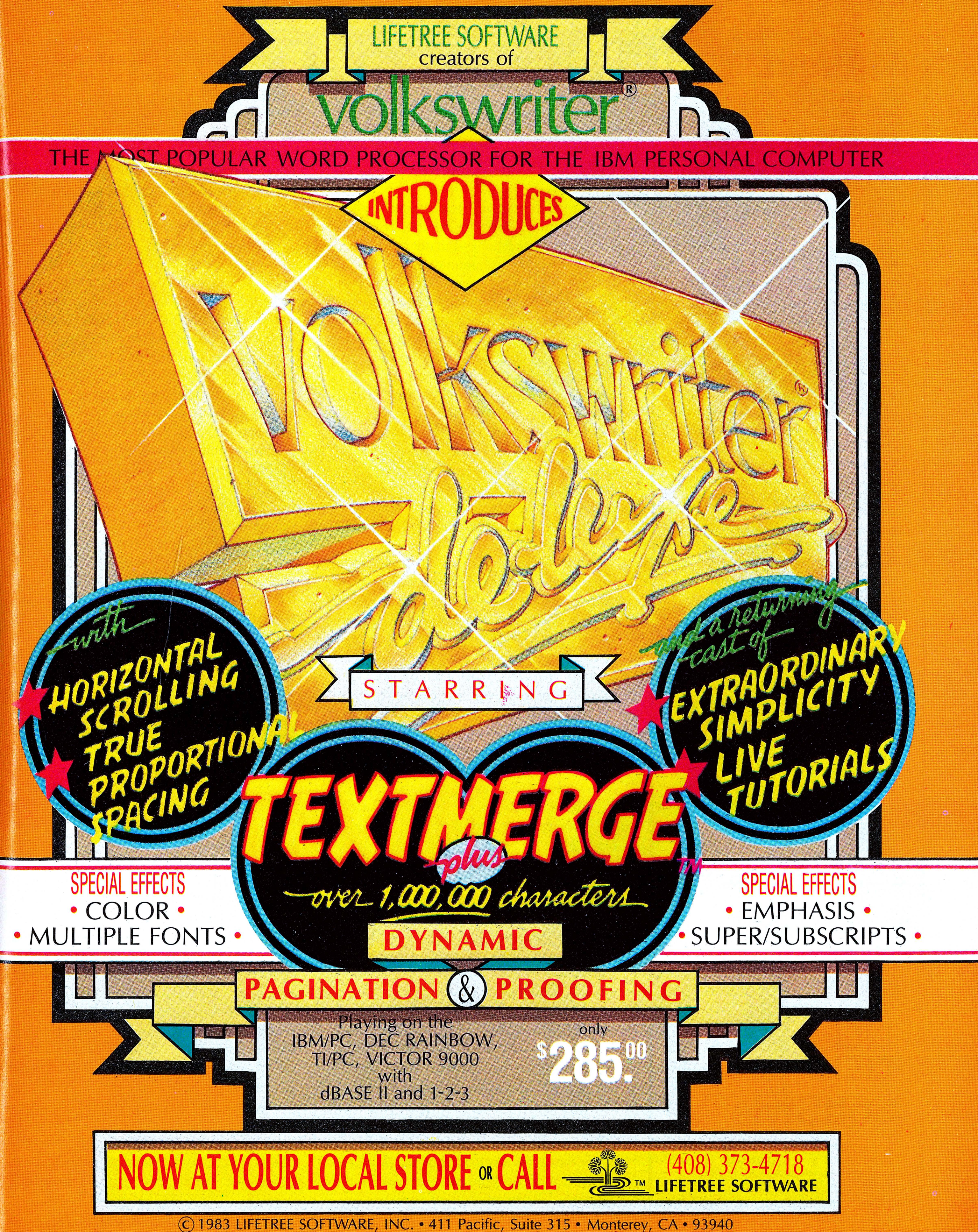
It will be about ten years before we'll see much in the way of photorefractive crystal data storage systems. "It's possible we'll see specialized applications before then," says Boatner. DH

AT&T

continued from page 191

IRD predicts that the competition between IBM and AT&T will significantly affect the strategies of Apple and other hardware and software firms. The report forecasts that virtually all future micros, at least for the next few years, will have to include MS-DOS and Unix capabilities to compete.

The 237-page *Microcomputer Operating System Strategies* report is available from IRD for $1,650. A description and a copy of the table of contents are free. DH



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Network

continued from page 191

software designed to teach them how to operate the computer.

This computerized educational system bears some resemblance to the traditional correspondence school—but not much. True, the student does communicate with the instructor through the mail. But in this case, the mail is electronic and pupil and instructor can interact, regularly discussing the course material as they work through it. The fact that students can learn (and teachers can teach) at their own convenience is another major plus of the system. There are no scheduling conflicts to overcome, no transportation arrangements to make, no parking problems to contend with. Instead, class begins whenever you want, wherever you want. You take tests when you're ready, not before, and feedback, guidance, and clarification are there for the asking. What more could a student want?

As of this writing, some 170 TeleLearning courses are on-line, and more are in the planning stages. Course fees range from $35 on the low end to around $150 on the high end; such factors as instructor, length of course, complexity of material being taught, and cost of supplementary course material are taken into account in establishing course fees.

The biggest news, beyond the existence of the TeleLearning system itself, is the fact that the system software and the company's expertise are available for a fee so that corporations, educational institutions, and public and private agencies can create and teach TeleLearning courses of their own. Some already have.

When TeleLearning chairman Ron Gordon and president Tom White founded the company, their primary objective was to devise a way of using technology to make educational opportunities more accessible to more people. They planned to create and market a learning system that would facilitate this turn of events.

TeleLearning's host computer is a Prime 850. Connections between a personal computer and the host are made through one of the three packet-switching networks—Tymnet, Telenet, and Uninet. To get started, a first-time user is prompted to look up a local access code number in the catalog and enter it at the keyboard. This lets TeleLearning know where the user is located; from that point on, the system does all the work of making the necessary telecommunication connections.

Like a regular modem, the knowledge module hardware connects a personal computer to a telephone jack and makes use of the phone lines to transmit and receive information. The TeleLearning software ensures that the communication process is "transparent to the user." And a communications analysis system built in to the software enables the system to look at the linkage at every step and to make whatever adjustments are necessary to ensure that the user does get connected with one of the three networks.

Because the dialing, log-on procedures, passwords, and other business are handled by the software, the jargon that once seemed to be inextricably linked to telecommunication is eliminated. The company is now at work on additional software to further simplify telecommunications. The software will make using the "knowledge module" modem for other than TeleLearning-related purposes as easy as it is to use within the TeleLearning environment.

Once a student has bought the Knowledge Module package, he or she is ready to enroll in the "electronic university." The first step is to choose the desired course or courses from the catalog. The student registers electronically by filling in pertinent information, such as credit card number, in an order form that appears on-screen. It's also possible to register by mail—for those who haven't yet entered the "age of plastic." As soon as the student's credit card number is verified (or the check clears), the enrollment process is complete.

Within twenty-four hours of signing up for a TeleLearning class, a textbook and any other course materials a student needs are sent out. If the course calls for graphics or other special information, there may be a need for an additional disk or two. All these materials, and all of the costs involved in using the system—communicating with the instructor, and so on—are covered in the course fee paid at the time of enrollment. And once they've signed up for one class, students automatically receive quarterly updates of the system's offerings.

When beginning a course, the student is greeted by a digitized photograph of the instructor. After introductions have been made, an overview of the course is next. Then it's the student's turn to tell the instructor why he or she is taking the class, what the student hopes to get out of the course, and so on. Having this information enables the instructor to be more helpful, to individualize the course to meet a particular student's needs.

All interaction with the system is accomplished by following instructions spelled out in on-screen menus. And a simple text editor

GOTO page 198, column 2

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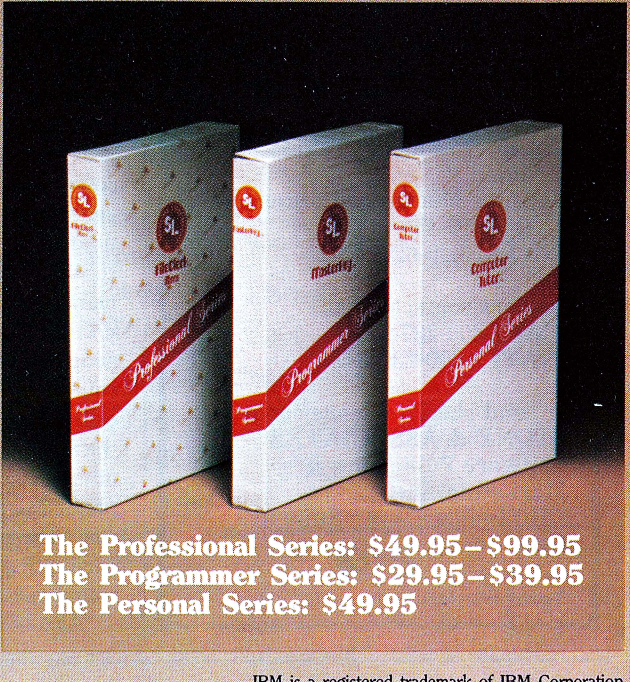
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Network

continued from page 196

included in the software allows you to type in your questions, answers, and comments at the keyboard. The system software can also display and transmit graphics, tests, and other information. If you have a printer, you can also print out test questions and other course information.

There are two ways to communicate with your instructor—via electronic mail (the instructor will make an effort to get back to you promptly) or in person, with an appointment during the instructor's "office hours." Each instructor contracts to spend a certain amount of time "on-line" working with students.

TeleLearning found most of its instructors by placing ads in the campus newspapers of accredited colleges and universities. The fact that these instructors had already taught the courses in a regular classroom environment was considered a plus.

The company is working with various accredited educational institutions that are interested in exploring the possibilities of TeleLearning.

Tom White explains. "Our whole approach," says White, "is not for TeleLearning to be an accredited institution, but for us to work with these instructors so they can offer accredited courses via TeleLearning."

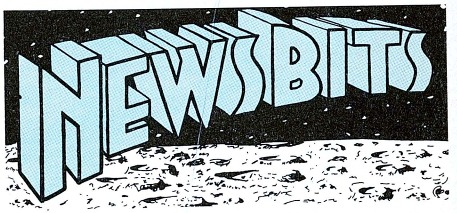
At present, TeleLearning's offerings span three broad areas: adult learning, business education, and courses for children and young adults.

Study topics for adults include everything from parenting to first aid for the weekend athlete, from reading aloud to your child to basic auto mechanics, from starting and managing your own business for profit to improving your word power. Business courses cover such subjects as microcomputer report generation for business, telecommunications, the efficient use of word processing, construction cost estimating, and property management. Also available are courses on *dBase II* and database concepts. For young people, the fare includes a computer-literacy course "for kids and other beginners," a class called Write On, and another called Solving the SAT. A series of courses about space and other science classes are also offered. College preparatory courses in everything from marine biology to writing with style, algebra, accounting, psychology, and economics, round out the bill.

Also listed in the current catalog are five courses developed with the American Academy of Management, on such subjects as communication skills for managers, and administering the company budget.

According to White, there are a couple of ways organizations can work with TeleLearning to develop computerized educational and training courses of their own. The first way is by contracting with TeleLearning to convert their courses to software for a fee. The second way is by licensing the actual course-writing system and creating the software themselves. Student software and instructor software, as well as knowledge modules, are also available for purchase on an OEM basis.

An organization or educational institution that decides to create courses to be converted by TeleLearning becomes a participant in a multistep process consisting of submission, editing, feedback, and modification. The end result of this interaction is TeleLearning software for use in courses designed by the clients themselves and taught by the instructors of their choice. TeleLearning is also set up to train clients in the use of the system to write their own software. Fittingly, the company has even devised a training course that runs on the TeleLearning system. JV



∆ Industry Looks for a High/Low Split. The Fall '83 Comdex rolls into Las Vegas November 28, and the computer industry will try to improve its fortunes. The semiannual dealer show will feature a keynote address by Microsoft's cofounder Bill Gates and fifty-two conference sessions on everything from management methods to market trends. Several hundred exhibitors will invade the Riviera, Sahara, and Las Vegas Hilton hotels, as well as the Las Vegas Convention Center. Comdex is one of the premier trade shows for introducing new products and making business deals. The show is organized by The Interface Group in Needham, Massachusetts.

∆ Get Together and Get Down. The T.E.D. (technology, entertainment, and design) Communications Conference will be held February 23–26, 1984, at the Monterey Conference Center in Monterey, California. The theme of the conference is the design of information as entertainment. An impressive lineup of artists, thinkers, and professionals in the technology and entertainment industries will explore with attendees, through visual and audio presentations, the process of being informed through entertainment.

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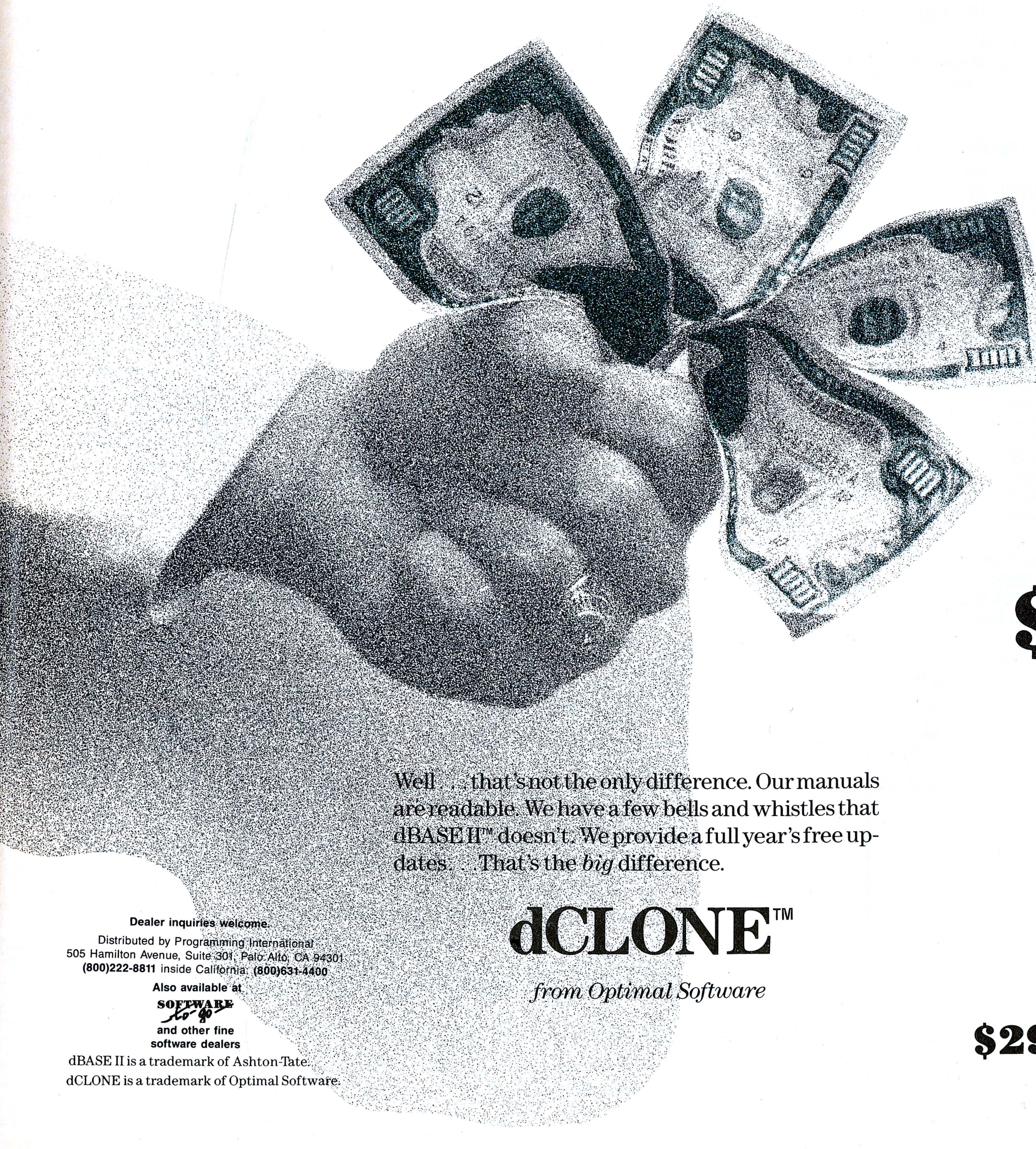

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"Active Trace saved my a!"** said a man whose business is programming and customizing. "I don't work without it."

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"Extremely useful program," said a professional reviewer.* "If you do much programming in Microsoft Basic, you'll appreciate Active Trace a lot."

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*Jerry Pournelle, *BYTE Magazine*, April '83, p 234.

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Scheduled to make presentations at the four-day conference are filmmaker Robert Abel, Pentagram's Colin Forbes, jazz musician Herbie Hancock, electronic musician Suzzane Ciani, publisher Stewart Brand, and computer graphics wizard Benoit Mandelbrot. The keynote speaker is Frank Stanton, president emeritus of CBS. The conference is aimed at professionals who are involved with the creation and distribution of information. For more information, contact the conference director, Judi Skalsky, at the T.E.D. Communications Conference office in Los Angeles, California.

Δ **Midwest Educational Computing.** A three-day conference, The Role of the Computer in Education IV, will be hosted by Micro-Ideas (Glenview, IL), March 8—10, 1984 at the Arlington Park Hilton in Arlington Heights, Illinois. The conference will feature several day-long seminars and many sessions covering a wide range of educational topics. For further information contact Micro-Ideas.

Δ **New Screen for Portable Machines?** When British inventor Clive Sinclair introduced his micro TV two months ago, computer industry analysts were impressed by the mini-boob tube's two-inch flat screen. Unlike two new Japanese micro TVs, whose flat screens use digital-watch technology, Sinclair's set produces a conventional picture by beaming the image from the side rather than the back of the screen. Sinclair, who made a bundle with the Sinclair 1000 and other low-cost computers, may have found the answer to the computer industry's need for a low-cost flat-screen monitor to be used in the growing wave of portable computers.

Δ **Chip Watch.** IBM announced the development of a still experimental 512K dynamic RAM chip. The chip is the first "ever to use an electronic technique called 'plate pushing' to read data out of its storage cells, " the company said. Plate pushing produces a strong electrical signal that increases a chip's memory density and reliability. The chip is smaller than a fingernail.

Δ **Whoops.** When the U.S. Army engaged Boeing Computer Services (BCS) to help its recruiters, the brass expected the cost to be about $10,000 a month. They were in for a shock. The first month's bill came to $1.3 million. The Navy too engaged BCS for help in its recruiting. The expected first month's bill of $12,000 came to $350,000. The Army will spend $120 million during its five-year contract with BCS instead of the original estimate of $8.5 million, according to the General Accounting Office (GAO). What happened? The GAO says that such cost overruns are typical in government teleprocessing contracts. The reason? Federal agencies are notorious for underestimating how much computer time they'll need. BCS is not the only computer company to shock government agencies. An audit, performed after the cost overruns in the Army and Navy recruiting systems were uncovered, found that in eleven computer contracts the expected costs of $36.1 million will end up costing taxypayers $165.8 million. That's a cost overrun of 360 percent. Ouch.

Δ **The Emperor's New Clothes.** What's a once-profitable subsidiary of a giant conglomerate to do when it loses several hundred million dollars in a year? Build new headquarters, what else? Sunnyvale, California-based Atari announced plans to develop a major office complex on sixty-five acres of land in San Jose, owned by its parent company, Warner Communications. Construction on the $60-million project is expected to begin by the second quarter of next year, with occupancy scheduled for early 1985. Atari expects to house its research and development, marketing, and distribution offices in about four hundred thousand square feet in four buildings.

Δ **Supercomputer Sibling.** Cray Research, purveyors of multi-million-dollar supercomputers, has announced the formation of a new company, Circuit Tools. The new company will be headed by John C. May, former manager of electrical engineering applications at Cray, and based in Santa Clara, California. Circuit Tools will operate as a subsidiary of Cray Research and develop and market software programs for use in the design of very large scale integrated circuits. Initially, the company will offer two software programs. One will be in the area of circuit simulation, used to verify the design of an integrated circuit. The other will be in timing simulation, used to obtain an accurate overview of the performance of a circuit. In other Cray news, the company's founder, Seymour Cray, has extended his agreement to act as an independent contractor to Cray Research until the end of 1987. Mr. Cray is known to be exploring the use of gallium arsenide in the development of integrated circuits.

Δ **Don't Leave Home.** DataPlus (San Rafael, CA) has released a 197-page book profiling home-banking activities in the United States. *Home Banking Review: 1983* profiles the financial institutions, systems operators, and technological innovators who are driving the home-banking industry. The review links personal computers to the success of almost half of the systems currently being implemented. ▲

Editor
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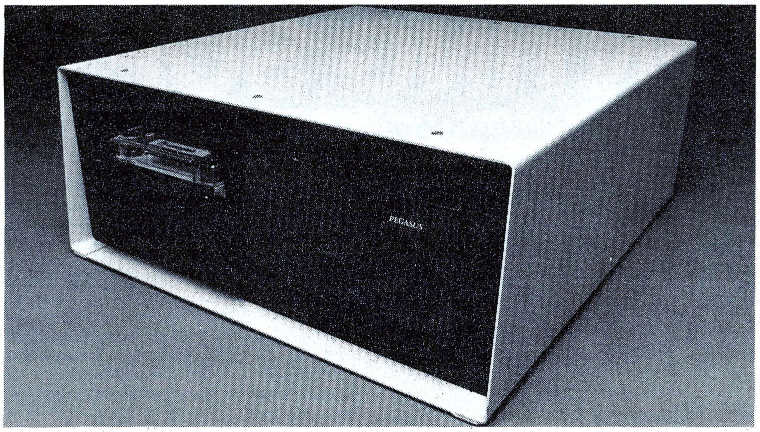

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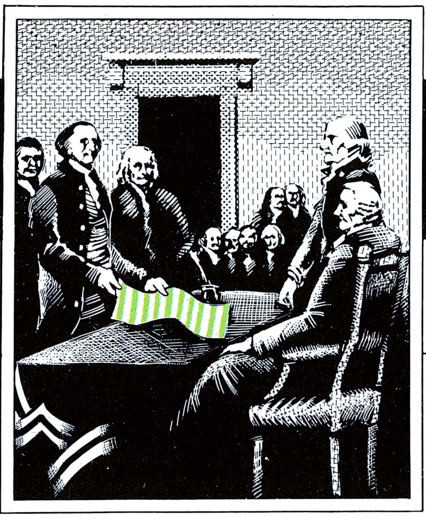

THE RIGHT TO ASSEMBLE

by Ray Duncan

An Introduction to EXE Programs

Many *Softalk* readers have written to express their confusion about the many commands listed in the Microsoft *Macro Assembler* manual. This assembler is so powerful and complex, and the manual so large and detailed, that it is difficult to glean the information necessary to put together a simple executable program. In this month's column we will introduce such a framework and then elaborate on it to produce a more useful utility.

In recent months, we have presented the MEMSIZE, VMODE, and CLEAR utilities as vehicles for discussion of PC-DOS and ROM BIOS service calls. All these programs were written in such a way that they could be assembled into COM files; this way, we could pay more attention to the structure and action of the programs themselves and do minimal worrying about control of the assembler. However, programs of the COM type have some definite disadvantages, and most serious assembly language efforts for the pc are written to be converted into EXE files.

While COM type programs effectively are restricted to a total of 64K for machine code, data, and stack combined, EXE programs can be of practically any size (up to the limit of the computer's addressing capability). EXE programs also separate the code, data, and stack into separate modules for the loader. At present, since PC-DOS does not support multiple concurrent tasks, this is only marginally important. But when PC-DOS 3.0 with multitasking appears on the scene, the ability to load different parts of large programs into several separated memory fragments, as well as the opportunity to designate a "pure" code portion of your program that can be shared by several tasks, will become very significant.

When learning to use a new computer or language processor, it usually is helpful to write a very simple program that includes the basic set of assembler/compiler controls, requires the full sequence of edit/compile/link/execute, yet contains no complicated code that will need debugging. Traditionally, programmers perform this exercise by writing a program that simply prints "Hello" on the principal output device and then exits. Once you can do this successfully, you have the "operational" problems under control and can turn your attention to writing elegant program code.

The HELLO.EXE Program. Let us not abandon time-honored traditions. The "Hello" program in listing 1 demonstrates the fundamental structure of an assembly language program that is destined to become an EXE file. At minimum, it should have a module "name," a "code segment," a "stack segment," and a primary "procedure" that receives control of the computer from PC-DOS after the program is loaded. The program also contains a "data segment" to provide a more complete example. Let's inspect all the pieces of the program in detail.

The NAME statement on line 1 simply provides a module name for use during the linkage process. If the NAME command is not present in the source file, the first six characters of the text provided in the TITLE statement are used as the module name. If neither of these is present, the linker will simply use the filename. Although the NAME statement is not mandatory, it's good practice to use it—as an aid to documentation and understanding the map produced by the linker and to keep the module name from defaulting to something that will cause trouble later.

The PAGE command, when used with two operands as in line 2 of Hello, defines the length and width of the page. These default to 66 and 80 respectively. If you use a PAGE command within your listing without any operands, it causes a form feed to be sent to the printer and a heading to be printed. Use the PAGE command liberally to place each of your subroutines on separate pages for easy reading.

The TITLE command, on line 3, specifies the text string (limited to 60 characters) to be printed on the upper left corner of each page. The TITLE command is optional, but it cannot be used more than once in each assembly language source file.

Dropping down past a few comments and EQUATE statements, we come to a declaration of a CODE segment that begins on line 19 with a SEGMENT command and is terminated on line 53 with an ENDS command. The CODE segment is given a name, "cseg," by the label in the leftmost field of the line, and is given certain attributes, "para," "public," and "CODE," by the operand fields on the right end of the line. You will find it helpful to read pages 5-38 through 5-41 in the assembler manual for de-

1. Extended file-handling services with handles and path name support. Available in PC-DOS 2.0 only, as functions 3CH to 46H via software interrupt 21H. Provided by the PC-DOS BDOS.
2. Traditional file-handling services (descendants of those available under CP/M on eight-bit microcomputers). Available in PC-DOS 1.x and 2.0, as functions 12H to 24H and 27H to 29H via software interrupt 21H. Provided by the PC-DOS BDOS.
3. Device-independent absolute disk read and write, available via software interrupts 25H and 26H. Provided by the PC-DOS BIOS.
4. Device-dependent (disks only) absolute read and write, available via software interrupt 13H. A service of the ROM BIOS, hence usable under all operating systems.
5. Disk I/O by direct access to the disk controller chip. Used by many copy-protected programs to read nonstandard sectoring schemes.

Table 1. Hierarchy of disk access services in PC-DOS (the most complex and abstract are at the top of the list; the most "primitive" or hardware-dependent are at the bottom).

tailed explanations of each possible attribute of a segment. This particular use of SEGMENT tells the linker to expect executable machine code, which must be properly modified and relocated when it is loaded into RAM from the disk.

Following the CODE SEGMENT instruction, we encounter an ASSUME statement on line 21. The concept of ASSUME often baffles new assembly language programmers. In a way, ASSUME doesn't "do" *anything.* It only tells the assembler which segment registers you are going to use to point to the various segments of your program so that the assembler can provide segment overrides when necessary. But it's important to notice that the ASSUME statement doesn't take care of loading the segment registers with the proper values; it just notifies the assembler of *your* intent to do that within your program. Read more about it on page 5-4 of the assembler manual.

Within the CODE SEGMENT, we come to another type of block declaration begun with the PROC command on line 23 and closed with the ENDP on line 50. These two instructions delimit a *procedure,* or block, of executable code that performs a single distinct function. The procedure is given a name by the label in the leftmost field and an attribute in the operand field. If the procedure carries the "Near" attribute, it can be called only by other code in the same segment, while procedures with the "Far" attribute can be called from code located anywhere in the 8088's memory addressing space. Since our procedure in this example, PRINT, is going to be called from PC-DOS, we give it the Far characteristic.

Within the procedure PRINT, our first action is to push the address for the final return to PC-DOS on the stack—not really necessary in this simple short program but vital in larger programs with many linked code modules. Next, we initialize the Data Segment register as we told the assembler we would in the earlier ASSUME statement (the Code Segment and Stack Segment registers were set up automatically by PC-DOS). We load the offset of the message string into the DX register and use PC-DOS function 9 to print it on the screen. Finally, a RET instruction in line 46 uses the segment and offset we pushed onto the stack in lines 28 to 30 to exit to PC-DOS. At this point, you may want to stop and look over pages E-3 through E-8 of the PC-DOS 2.0 manual, which describe the state of the registers and the Program Segment Prefix on entry into an EXE program.

Now let's examine lines 60 to 65. Here we declare a DATA SEGMENT, named "dseg," that contains the variables and constants used by our program. The linker knows that this portion of the program does not include any executable machine code. If the various modules of your program contain multiple data segments with the same name, they all will be collected by the linker and placed in the same physical memory segment.

Lines 71 to 78 establish a STACK SEGMENT; PUSH and POP instructions will access this area of scratch memory. Before PC-DOS transfers control to your program, it sets up the Stack Segment Register and the Stack Pointer according to the size and location of the Stack Segment declared in your

Function 0—Reset disk system
Call with:
AH = 0
Returns:
N/A
Function 1—Return disk system status
Call with:
AH = 1
Returns:
AL = status byte, interpreted as follows:

Bit	Significance
7	disk time/out (failed to respond)
6	seek failure
5	controller error
4	checksum error on disk read
3	DMA overrun on operation
2	requested sector not found
1	disk write failed because of write protect
0	illegal command passed to driver

Function 2—Read disk
Call with:
AH = 2
DL = drive number (0−3)
DH = head number (0−1)
CH = track number (0−39)
CL = sector number (1−9)
AL = number of sectors to transfer (1−8)
BX = offset of user's disk I/O buffer
ES = segment of user's disk I/O buffer
Returns:
AH = disk status, 0 = successful operation, otherwise bits as described under function 1.
AL = number of disk sectors actually transferred
Carry bit = 0 if successful operation
Carry bit = 1 if error
Function 3—Write disk
Call with:
AH = 3
Other registers as described for function 2 (read disk)
Returns:
Registers and status same as function 2
Function 4—Verify sectors
Call with:
AH = 4
Other registers as for function 2
Returns:
Status same as function 2
Function 5—Format track
Call with:
AH = 5
BX = offset of address field list
ES = segment of address field list
Returns:
N/A
Note: the proper use of function 5 is beyond the scope of this column. It assumes a detailed understanding of the disk controller chip.

Table 2. Direct disk access functions available by calling ROM BIOS software interrupt 13H.

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program. Make sure you allow enough room for the maximum stack depth that can occur at runtime, plus a safe number of extra words for registers pushed onto the stack during a PC-DOS service call. If the stack overflows, it may damage some part of your other code and data segments and cause your program to behave strangely or crash altogether!

The END statement on line 84 winds up our little Hello program, telling the assembler it has reached the end of the source file and providing the name of the point of entry from PC-DOS.

In summary, the Hello program provides you with the skeleton of a sophisticated assembly language program that invokes many of the capabilities of the Microsoft *Assembler.* Go ahead and use your favorite program editor to type the source code into a file named HELLO.ASM. If you don't understand all the commands yet, don't worry—we are just trying to give you a shell that you can incorporate into your own programs in a very cookbook-like manner. Once the source file has been created, you can assemble and link it as follows:

```
A>ASM HELLO,HELLO,
   HELLO,HELLO,
A>LINK HELLO,HELLO,,,
```

Now you will find the file HELLO.EXE on your disk, which you can execute simply by entering:

```
A>HELLO
```

If everything went right, you will see:

```
A>HELLO
Hello!
 A>
```

The DISKTYPE.EXE Program. Now that you've worked your way through the Hello program, let's use these new tools to write a more useful utility named DISKTYPE. DISKTYPE is compatible with both PC-DOS 1.1 and 2.0 and can be used to report the format of any disk: single- or double-sided, eight or nine sectors per track. Luckily for our purposes, the second physical sector of any PC-DOS disk always contains the File Allocation Table, and the first byte of that table is a code for the disk type. So you can use this utility under PC-DOS 1.1 to find out if a disk is formatted for PC-DOS 2.0. You can even use it on a single-sided disk drive to check if a disk is formatted for two-sided use—all without risking the data on the disk.

DISKTYPE can be used either with a drive selector, such as:

```
A>DISKTYPE B:
```

in which case it will examine the disk in the specified drive, or it can be used alone:

```
A>DISKTYPE
```

to display the format of the disk in the default drive (in this case, A). The drive selector, if given, must be in the range A to D. If the disk is not in any currently supported PC-DOS format (for example, a CP/M-86 disk), you will receive the message "Diskette. . .is unknown to this program".

The general flow of control for the program DISKTYPE is as follows:

1. Save the address for the final return to PC-DOS on the stack.
2. Examine the command tail passed by PC-DOS to see if the user specified any particular disk drive.
3. If disk drive was specified, make sure it is legal (in the range A to D).
4. If no disk drive was specified, call PC-DOS function 19H to get the identity of the default drive.
5. Turn the drive code into a lower-case ASCII letter and store it into the output string.
6. Read track 0, head 0, sector 2 of the disk into the scratch area named BUFFER. This sector contains the beginning of the PC-DOS File Allocation Table.
7. Get the first byte of buffer and try to match it against the codes in the table named "diskk."
8. Print the appropriate message by calling PC-DOS function 9.
9. Give control back to PC-DOS with a RET instruction.

For convenience, all the executable code, constants, and variables are lumped together inside a single CODE segment, instead of declaring a separate DATA segment as we did in the Hello program. A Stack Segment still is present, as is required for all programs of the EXE type.

In order to read the disk, DISKTYPE makes a direct call to the ROM BIOS disk driver through software interrupt 13H. An entire hierarchy of disk access services is available on the pc under PC-DOS (see table 1); the one we are using here is the most primitive except for direct control of the disk hardware interface. Six different functions are available through interrupt 13H; they are summarized in table 2. The general calling sequence is:

```
MOV AH,function ;AH contains a code
•               ;for the operation type.
•               ;load other registers with
•               ;function-specific values.
INT 13H         ;call the ROM BIOS
```

The segment registers are preserved, as are registers BX, CX, DX, SI, DI, and BP. Register AX is used to return results or status.

Within the data area of the DISKTYPE program, the table named "diskk" warrants closer scrutiny. The table contains six entries; each entry consists of a single byte, which is the disk format code followed by a word that contains the address of the descriptive message for that format. In PC-DOS 2.0, five format codes have been documented:

0FFH 2 sided, 8 sectored
0FEH 1 sided, 8 sectored
0FDH 2 sided, 9 sectored
0FCH 1 sided, 9 sectored
0F8H Fixed disk

Although the DISKTYPE program using INT 13H is not capable of reading from the hard disk, we put an appropriate entry into the table anyway as an illustration. A 0 byte followed by the address of the "unknown format" message terminates the table. If the program gets this far, it knows that it is not looking at a standard PC-DOS disk (other possibilities include a CP/M-86 or QNX disk). If the disk is uninitialized, you'll also get the BDOS "Read Error" message from the operating system.

What about codes 0FBH, 0FAH, and 0F9H? Your guess is as good as mine. However, the existence of that three-code gap makes one wonder what Microsoft has in mind for the next version. . .maybe support for eighty-track 5¼-inch drives, or the new 3¼-inch drives.

As a test of your understanding of the DISKTYPE utility, change the disk access method to use INT 25H, the PC-DOS absolute disk read service (see PC-DOS 2.0 manual page D-9). This function is not hardware-dependent and can be used to fetch sectors from the fixed disk and RAM disks as well as from floppy disks. Watch out; there are a few tricky aspects to this conversion! ➤

```
1                                  name       hello
2                                  page       55,132
3                                  title      'HELLO—print Hello on terminal'
4                        ;
5                        ; HELLO utility to demonstrate various parts
6                        ; of a functional assembly language program,
7                        ; use of segments, and a PC-DOS function call.
8                        ;
9                        ; Ray Duncan, September 1983
10                       ;
11                                                          ;show use of some EQUATES:
12   = 000D              cr        equ        0dh           ;ASCII carriage return
13   = 000A              lf        equ        0ah           ;ASCII line feed
14                                                          ;
15                       ;
16                                                          ;begin the "Code" segment
17                                                          ;containing executable
18                                                          ;machine code
19   0000                cseg      segment    para public 'CODE'
20                       ;
21                                 assume     cs:cseg,ds:dseg,ss:stack
22                       ;
23   0000                print     proc       far           ;actual program code
24                                                          ;is completely contained
25                                                          ;in the "procedure" named
26                                                          ;"PRINT".
27                                                          ;
28   0000  1E                      push       ds            ;save DS:0000 on stack
29   0001  33 C0                   xor        ax,ax         ;for final exit to PC-DOS.
30   0003  50                      push       ax
31                                                          ;set Data Segment Register
32                                                          ;to point to the Data Segment
33                                                          ;of this program, so that the
34                                                          ;message we want to print is
```

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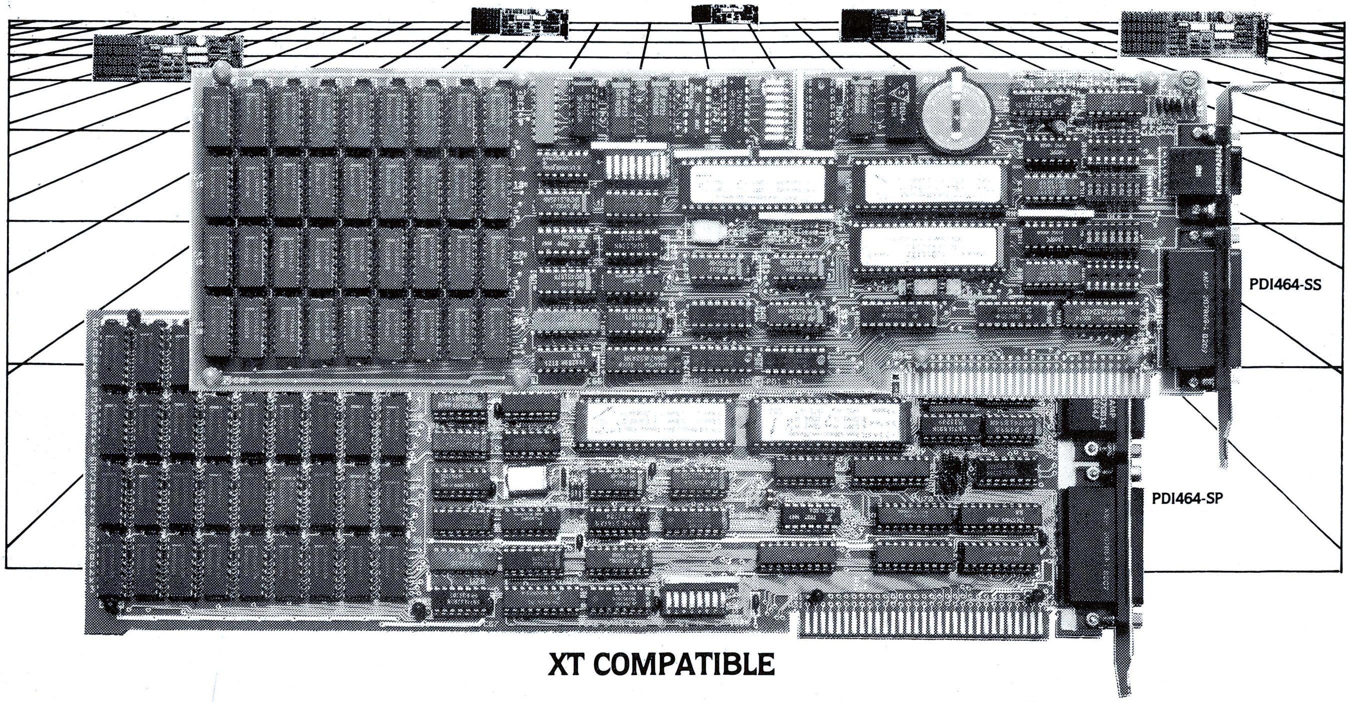

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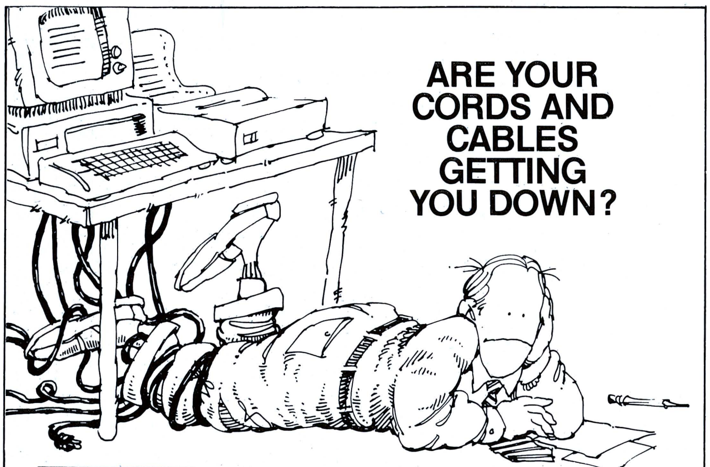
```
                                                  ;addressable.
0004  B8 ----    R                 mov      ax,seg dseg
0007  8E D8                        mov      ds,ax
                                                  ;now put the offset of the
                                                  ;message text into DX,
0009  BA 0000    R                 mov      dx,offset message
                                                  ;now DS:DX specifies the
                                                  ;full address of the message.
000C  B4 09                        mov      ah,9  ;use the PC-DOS function 9
000E  CD21                         int      21h   ;to print the string.
                                                  ;
0010  CB                           ret            ;now return to PC-DOS using
                                                  ;the addresses we pushed on
                                                  ;the stack at entry.
                                                  ;
0011                     print     endp           ;end of the "procedure"
                                                  ;named "PRINT"
                                                  ;
0011                     cseg      ends           ;end of the code segment
                                                  ;containing executable
                                                  ;program.
                                                  ;
                                                  ;now we define a data segment
                                                  ;containing our program's
                                                  ;constants and variables.
0000                     dseg      segment  para 'DATA'
                                                  ;
0000  0D 0A 48 65 6C 6C  message   db       cr,lf,'Hello!',cr,lf,'$'
      6F 21 0D 0A 24
                                                  ;
000B                     dseg      ends
                                                  ;
                                                  ;lastly, we define a Stack
                                                  ;Segment which contains
                                                  ;a scratch area of memory
                                                  ;for use by our program's stack
0000                     stack     segment  para stack 'STACK'
                                                  ;allow 64 bytes in this case
0000     40 [                      db       64 dup (?)
               ??
                  ]

                                                  ;
0040                     stack     ends
                                                  ;the final "End" statement
                                                  ;signals the end of this
                                                  ;program source file, and gives
                                                  ;the starting address of
                                                  ;the executable program
                                   end      print
```

Listing 1.

```
                              name      disktype
                              page      55,132
                              title     'DISKTYPE---display diskette type'
                    ;
                    ; DISKTYPE utility to display the
                    ; format type of selected diskette
                    ;
                    ; Ray Duncan,  Uncopyright (u) September 1983
                    ; This program may be freely copied,
                    ; mangled, enhanced, and redistributed.
                    ;
  = 0080            input     equ       080h      ;command line tail buffer
  = 000D            cr        equ       0dh       ;ASCII carriage return
  = 000A            lf        equ       0ah       ;ASCII line feed
                    ;
0000                cseg      segment   para public 'CODE'
                              assume    cs:cseg,ds:cseg,ss:stack
                    ;
                    ; This program becomes an EXE file.  On entry
                    ; from PC-DOS, CS = address of entry point, IP = 0,
                    ; SS = segment address of stack segment, DS and
                    ; ES = segment address of Program Segment Prefix area.
                    ;
0000                disktype  proc      far       ;entry point from PC-DOS
                                                  ;
0000  1E                      push      ds        ;put final return address
0001  33 C0                   xor       ax,ax     ;on stack (DS:0000)
0003  50                      push      ax        ;for "Far Return" later.
                                                  ;DS=segment of program
                                                  ;prefix with command tail,
                                                  ;set SI=offset of command
                                                  ;tail's length byte,
0004  BE 0080                 mov       si,offset  input
0007  FC                      cld                 ;clear the Direction Flag
                                                  ;for "LODS" string instruction.
0008  AC                      lodsb               ;check length byte to see if
0009  0A C0                   or        al,al     ;there's any command tail.
000B  74 17                   jz        disk2     ;no, use default drive.
                                                  ;
000D  AC            disk1:    lodsb               ;check the next byte of
                                                  ;the command tail,
000E  3C 0D                   cmp       al,cr     ;if carriage return,
0010  74 12                   je        disk2     ;use "default" disk drive.
0012  3C 20                   cmp       al,' '    ;if blank, keep scanning
0014  74 F7                   je        disk1     ;for another character.
0016  0C 20                   or        al,20h    ;fold the character to
                                                  ;lower case.
0018  3C 61                   cmp       al,'a'    ;make sure it's in range A-D
001A  72 50                   jb        disk8     ;no, print error message
001C  3C 64                   cmp       al,'d'
001E  77 4C                   ja        disk8     ;no, print error message
```



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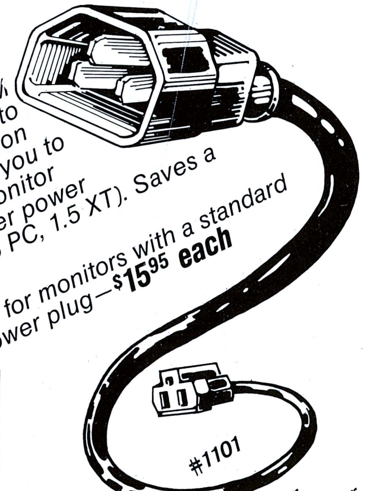

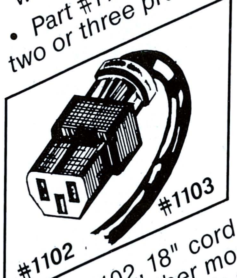

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```
0020 2C 61                         sub             al,'a'            ;make drive code 0-3
0022 EB 04                         jmp             short disk3
                                                                     ;
0024                     disk2:                                      ;if operator didn't specify
                                                                     ;disk drive, get the "default
                                                                     ;disk" from PC-DOS, returns
0024 B4 19                         mov             ah,19h            ;drive code in AL
0026 CD21                          int             21h               ;(0=A, 1=B, etc.)
                                                                     ;
0028 8C CB               disk3:    mov             bx,cs             ;now make DS and ES the
002A 8E DB                         mov             ds,bx             ;same as CS at entry
002C 8E C3                         mov             es,bx
002E 8A D0                         mov             dl,al             ;now put drive code in DL
0030 04 61                         add             al,'a'            ;form ASCII character for
                                                                     ;drive code and store it
0032 A2 00B8   R                   mov             diskc,al          ;into the output string.
0035 B6 00                         mov             dh,0              ;set head = 0 in DH,
0037 B5 00                         mov             ch,0              ;set track = 0 in CH,
0039 B1 02                         mov             cl,2              ;set sector = 2 in CL,
003B B0 01                         mov             al,1              ;set number of sectors
                                                                     ;to read into AL,
                                                                     ;put address of data
                                                                     ;buffer into BX,
003D BB 0172   R                   mov             bx,offset buffer
0040 B4 02                         mov             ah,2              ;AH=2 is read command,
                                                                     ;now call ROM BIOS
0042 CD13                          int             13H               ;to read first block of
                                                                     ;File Allocation Table.
                                                                     ;
0044 8A 1E 0172   R                mov             bl,buffer         ;pick up the first byte
                                                                     ;of FAT (contains code for
                                                                     ;disk format type) and
                                                                     ;set SI = start of disk
                                                                     ;type and message table.
0048 BE 0160   R                   mov             si,offset  diskk
004B AC                  disk4:    lodsb                             ;get next type from table.
004C 0A C0                         or              al,al             ;if zero we didn't match
                                                                     ;any valid type,
004E 74 09                         jz              disk5             ;so go print "unknown".
0050 3A C3                         cmp             al,bl             ;check byte from table against
                                                                     ;byte from diskette FAT sector.
0052 74 05                         jz              disk5             ;got a match,jump.
0054 83 C6 02                      add             si,2              ;bump the table pointer
                                                                     ;past the message address,
                                                                     ;and check next table entry.
0057 EB F2                         jmp             short disk4
0059 B4 09               disk5:    mov             ah,9              ;print first part of message,
005B BA 00A0   R                   mov             dx,offset diskb
005E CD21                          int             21h
0060 AD                            lodsw                             ;pick up the message address
0061 8B D0                         mov             dx,ax             ;for this disk type, put into
0063 B4 09                         mov             ah,9              ;register DX, and print it.
0065 CD21                          int             21h
                                                                     ;print final carriage return
                                                                     ;and line feed. . .
0067 BA 015D   R                   mov             dx,offset diskj
006A EB 05                         jmp             short disk9
                                                                     ;come here if letter other
                                                                     ;than A-D or a-d in command
006C                     disk8:                                      ;line, print "invalid disk".
006C 0E                            push            cs                ;make DS = CS  so error
006D 1F                            pop             ds                ;message is addressable.
006E BA 0076   R                   mov             dx,offset diska
                                                                     ;
0071 B4 09               disk9:    mov             ah,9              ;print message whose address
0073 CD21                          int             21h               ;is in register DX, then
0075 CB                            ret                               ;"Far Return" to PC-DOS
                         ;
0076                               disktype endp                     ;end of procedure DISKTYPE
                         ;
0076 0D 0A               diska     db              cr,lf
0078 49 6E 76 61 6C 69             db              'Invalid disk code.  Use A, B, C or D.'
     64 20 64 69 73 6B
     20 63 6F 64 65 2E
     20 20 55 73 65 20
     41 2C 20 42 2C 20
     43 20 6F 72 20 44
     2E
009D 0D 0A 24                      db              cr,lf,'$'
00A0 0D 0A               diskb     db              cr,lf
00A2 54 68 65 20 64 69             db              'The diskette in drive '
     73 6B 65 74 74 65
     20 69 6E 20 64 72
     69 76 65 20
00B8 78 3A 20 69 73 0D   diskc     db              'x: is',cr,lf,'$'
     0A 24
00C0 32 20 73 69 64 65   diskd     db              '2 sided, 8 sectors per track.$'
     64 2C 20 38 20 73
     65 63 74 6F 72 73
     20 70 65 72 20 74
     72 61 63 6B 2E 24
00DE 31 20 73 69 64 65   diske     db              '1 sided, 8 sectors per track.$'
     64 2C 20 38 20 73
     65 63 74 6F 72 73
     20 70 65 72 20 74
     72 61 63 6B 2E 24
00FC 32 20 73 69 64 65   diskf     db              '2 sided, 9 sectors per track.$'
     64 2C 20 39 20 73
     65 63 74 6F 72 73
     20 70 65 72 20 74
     72 61 63 6B 2E 24
011A 31 20 73 69 64 65   diskg     db              '1 sided, 9 sectors per track.$'
     64 2C 20 39 20 73
     65 63 74 6F 72 73
     20 70 65 72 20 74
     72 61 63 6B 2E 24
0138 66 69 78 65 64 20   diskh     db              'fixed disk.$'
     64 69 73 6B 2E 24
0144 75 6E 6B 6E 6F 77   diski     db              'unknown to this program.$'
     6E 20 74 6F 20 74
     68 69 73 20 70 72
     6F 67 72 61 6D 2E
     24
015D 0D 0A 24            diskj     db              cr,lf,'$'
                         ;
                         ; "diskk" is a table in which the byte
                         ;  signifying  a disk  format  is  followed
                         ; by the address  of  a  descriptive message
                         ;
0160 FF                  diskk     db              0ffh              ;2 sides 8 sectors
0161 00C0   R                      dw              diskd
0163 FE                            db              0feh              ;1 side 8 sectors
0164 00DE   R                      dw              diske
0166 FD                            db              0fdh              ;2 sides 9 sectors
0167 00FC   R                      dw              diskf
0169 FC                            db              0fch              ;1 side 9 sectors
016A 011A   R                      dw              diskg
016C F8                            db              0f8h              ;fixed disk
016D 0138   R                      dw              diskh
016F 00                            db              0                 ;unknown,end of table
0170 0144   R                      dw              diski
                         ;
0172 0200   [            buffer    db              512 dup (?)
               ??
                  ]

                         ;
0372                     cseg      ends
                         ;
0000                     stack     segment         para stack 'STACK'
0000     40 [            db        64 dup (?)
               ??
                  ]

0040                     stack     ends
                         ;
                                   end             disktype
```

Listing 2. ▲

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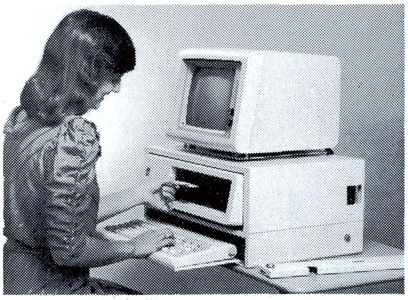

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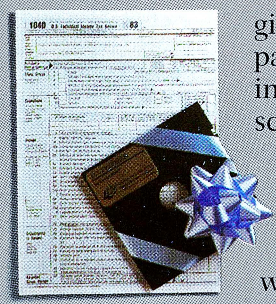

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The sun finally set on the British Empire.

Joe Louis finally lost a boxing match.

The Americans lost at basketball and the Russians at hockey in the Olympics.

And now *WordStar* has been dethroned.

This is no David and Goliath tale, however. It more follows the plot line of the decline and fall of the Roman Empire: a little attrition here, another bite there, and suddenly there're barbarians all over the place.

At least, that must be what it seems like to the folks at MicroPro these days.

First there were *EasyWriter 1.0, 1.1,* and *2.0* and *Volkswriter. WordStar* dispatched those aggressors with relative ease. Hovering in the background were such products as *WordPerfect, WordPlus-PC, Palantir,* and *Select*.

Then came the next wave of hostiles, and they finally overran the fort. *MultiMate* took a good chunk of the business market and *PFS:Write* got a fair share of the home market. *VisiWord, Perfect Writer,* and *PeachText* all found adherents.

When the dust settled in September, it was *WordPerfect* that was, by the narrowest of margins, the bestselling word processor for the pc. *WordStar* clung to second place, but *MultiMate* and *PFS:Write* were close behind. And coming on strong were *EasyWriter 2.0, Volkswriter,* and *PeachText*.

As if all that weren't enough to make MicroPro feel like a fox pursued by hounds, Microsoft was finally primed to make its move with its mouse-driven *Word*. Where will it all end? The seven wonders of the world disintegrated. Henry Ford finally painted a car a color other than black. IBM made a computer smaller than a breadbox (almost). *VisiCalc* was dethroned by one of VisiCorp's former employees. Now it's *WordStar*.

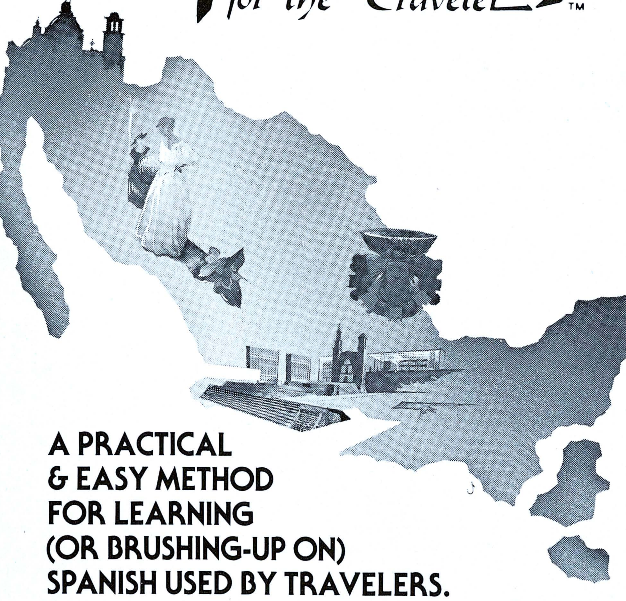
The MicroPro folks must be of a mind to believe that the cynics are right. Maybe there are no eternal verities such as Truth, Beauty, and Justice.

On the other hand, you'd be hard pressed to sell that philosophy to Mitch Kapor's hearty band of integrators at Lotus. Lotus took their stock public in October and the stock jumped six points—that's 1 + 2 + 3—on opening day to close several points higher than Apple Computer. That made instant millionaires out of several people and pumped a ton of filthy lucre into Lotus's coffers. Considering what Kapor did with his first million from VisiCorp, it's probable that pc owners will soon be sampling new delights.

There are other members of the software community who would adopt a more positive attitude about the marketplace—foremost among them being the group at Software Publishing Corporation. They continued to have three programs in the Top Thirty, and *PFS:File* made it into the number 2 slot behind *1-2-3*. *PFS:Write* closed more ground on the leaders, and *PFS:Report* held its ground as the thirteenth most popular program for the pc. *PFS:Graph* was sitting just outside the Top Thirty, giving Software Publishing arguably the strongest family of products extant.

Also unable to commiserate with MicroPro would be the folks at Satellite Software International and Softword Systems.

Satellite Systems publishes *WordPerfect*, the new champion word processor. For them, it's been a slow, gradual climb up the ladder of acceptability to this point. Their distribution is not as widespread as



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that of some of their competitor publishers, but *WordPerfect* is clearly the word processor of choice in those retail outlets where it's carried.

Softword Systems, on the other hand, seemed to appear with the speed of a comet. The difference is that their product, *MultiMate*, shows no signs of burning out. It gained a couple of positions to eighth in September and looks to be around for a long time.

Friday!, a companion product to *dBase II* from Ashton-Tate, was the highest-ranking newcomer to the list in September. *Friday!* hasn't taken off in the manner that many retailers expected, but its link to *dBase II* has been strong enough to guarantee it immediate attention.

The almost total lack of entertainment software reemphasizes the use of the pc as a business computer. Only *Microsoft Flight Simulator* falls into the category of entertainment, and it is clearly not a "game." *Snooper Troops I*, an educational program with a game orientation, is the only other product that could be considered frivolous on the list.

Everyone spoke as much of IBM's rumored next small computer as they did of the current market during October. The strength of IBM's position in the personal computer market is such that much commerce is being held in abeyance pending the introduction or renunciation of the "Peanut." In late October, it appeared to be a contest between IBM's Peanut and Coleco's Adam to see which machine could be last to market. A strange contest to say the least. ▲

IBM-franchised retail stores representing approximately 4.34 percent of all sales of IBM and IBM-related products volunteered to participate in the poll.

Respondents were contacted early in October to ascertain their sales for the month of September.

The only criterion for inclusion on the list was the number of units sold; such other criteria as quality of product, profitability to the computer store, and personal preference of the individual respondents were not considered.

Respondents in October respresented every geographical area of the continental United States.

Results of the responses were tabulated using a formula that resulted in the index number to the left of the program name in the Top Thirty listing. The index number is an arbitrary measure of relative strength of the programs listed. Index numbers are correlative only to the month in which they are printed; readers cannot assume that an index rating of 50 in one month represents equivalent sales to an index number of 50 in another month.

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This Month	Last Month	Index	
1.	1.	360.57	**1-2-3**, Mitch Kapor and Jonathan Sachs; Lotus Development
2.	6.	94.83	**PFS:File**, John Page and D.D. Roberts; Software Publishing Corporation
3.	12.	87.11	**Microsoft Flight Simulator**, Bruce Artwick; Microsoft
4.	4.	69.46	**dBase II**,Wayne Ratliff; Ashton-Tate
5.	30.	63.95	**WordPerfect**, Alan Ashton and Bruce Bastian; Satellite Software International
6.	2.	60.64	**Wordstar**; MicroPro
	3.	60.64	**Multiplan**, Microsoft; IBM
8.	10.	54.03	**MultiMate**; Softword Systems
	9.	54.03	**PFS:Write**, Sam Edwards, Brad Crain, and Ed Mitchell; Software Publishing Corporation
10.	27.	49.62	**Crosstalk**; Microstuf
11.	18.	45.20	**Basic Compiler**, Microsoft; IBM
12.	5.	44.10	**VisiCalc**, Software Arts/Dan Bricklin and Robert Frankston; VisiCorp, IBM
13.	13.	43.00	**PFS:Report**, John Page; Software Publishing Corporation
	17.	43.00	**Norton Utilities**, Peter Norton; Peter Norton Inc.
15.	8.	41.90	**Asynchronous Communications Support 2.0**; IBM
16.	22.	38.59	**Macro Assembler**, Microsoft; IBM
	23.	38.95	**EasyWriter II**, Basic Software Group; Information Unlimited Software
18.	23.	34.18	**Smartcom II**; Hayes Microcomputer Products
19.	11.	31.97	**Typing Tutor**, Michael Sierchio (Dick Ainsworth and Al Baker); IBM (Microsoft)
	25.	31.97	**Volkswriter**, Camilo Wilson; Lifetree
21.	7.	27.56	**Home Accountant Plus**, Mike Farmer, Bob Schoenburg, Larry Grodin, and Steve Pollack; Continental Software
	19.	27.56	**The Instructor**, Jo-L Hendrickson; Individual Software
23.	—	23.15	**Friday!**; Ashton-Tate
24.	—	22.05	**General Ledger**, John Moss and Ken Debower; IBM (BPI)
	30.	22.05	**MasterType**, Bruce Zweig; Lightning Software
26.	—	19.84	**ProKey**, David Rose; RoseSoft
27.	—	17.64	**Peachtext**; Peachtree
28.	14.	15.43	**Cdex Training for the IBM PC**, Rohit Patel; Cdex Corporation
29.	25.	14.33	**PC Tutor**, Lora Meise and Rick Lane; Comprehensive Software Support
30.	—	13.23	**Snooper Troops I**, Tom Snyder; Spinnaker Software
	—	13.23	**SuperCalc**; Sorcim

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